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AIRWORTHINESS AND FLIGHT CHARACTERISTICS TEST OF THE OH - 6A CONFIGURED TO A LIGHT COMBAT HELICOPTER (JOH - 6A LCH)

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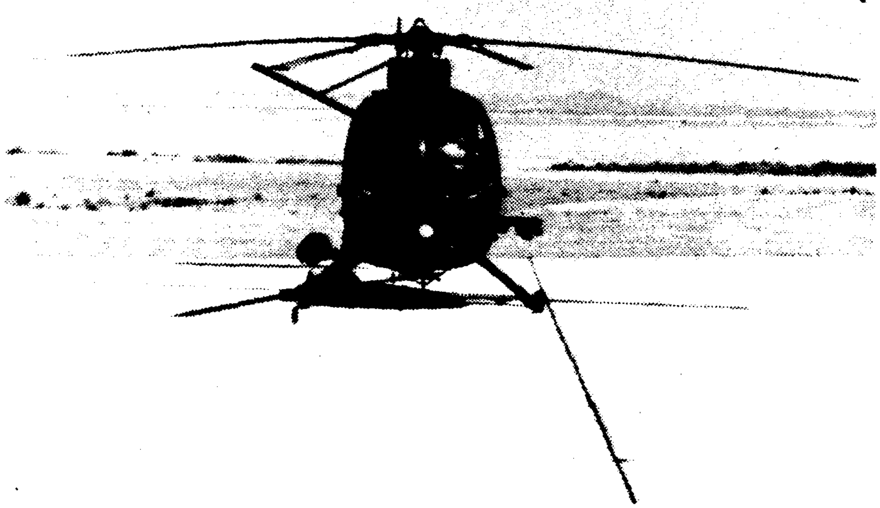

SINCE THE CONDUCT OF THIS TEST THE AIRCRAFT HAS BEEN REDESIGNATED THE AH - 6C.

UNITED STATES ARMY AVIATION ENGINEERING FLIGHT ACTIVITY
EDWARDS AIR FORCE BASE, CALIFORNIA 93523

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Limited Airworthiness and Flight Characteristics Test
Light Combat Helicopter
Handling Qualities

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The United States Army Aviation Engineering Flight Activity conducted a limited airworthiness and flight characteristics test of the JOH-6A Light Combat Helicopter (LCH), from 8 June through 10 August 1983. The JOH-6A LCH configuration increased mission gross weight to 2700 pounds and includes one 7-tube 2.75 inch rocket pod and one 7.62 mm minigun mounted externally. Performance and handling qualities were evaluated at test sites from near sea level (488 feet) to 9980 feet. A total of 44 flights were conducted requiring 34.6 productive

flight hours. The JOH-6A LCH in the present configuration has limited hover performance capabilities. With the exception of the excessive pilot workload at bank angles in excess of 45 degrees, the handling qualities were essentially the same as the basic OH-6A. One deficiency attributable to the LCH configuration was identified: the excessive pilot workload to maintain aircraft control at bank angles above 45 degrees. Four shortcomings were also identified of which three were directly related to the LCH configuration.

DEPARTMENT OF THE ARMY
HEADQUARTERS, US ARMY AVIATION SYSTEMS COMMAND
4300 GOODFELLOW BOULEVARD, ST. LOUIS, MO 63120

REPLY TO
ATTENTION OF

DRSAV-E

SUBJECT: Directorate for Engineering Position on the Final Report of USAAEFA Project 81-04, Airworthiness and Flight Characteristics of the OH-6A Configured to a Light Combat Helicopter (JOH-6A LCH)

SEE DISTRIBUTION

1. The purpose of this letter is to establish the Directorate for Engineering position on the subject report. The objectives of this Airworthiness and Flight Characteristics (A&FC) test were to obtain limited handling qualities and performance data at the maximum allowable gross weight of the JOH-6A helicopter (2700 lbs.). It should be noted that subsequent to this evaluation the JOH-6A has been redesignated AH-6C.

2. This Directorate agrees with the report conclusions and recommendations, with the exceptions identified herein. Conclusions and recommendations are discussed by paragraph as indicated.

a. Paragraphs 37 and 38. Correcting the deficiency of paragraph 37 or the shortcoming of paragraph 38 would require either a change in the rotor system or a reduction in weight. The aerodynamic capacity of the main rotor is presently at its operational limit due to the evolution of the configuration. Any further changes would require rotor system changes. There is no plan for the new rotor system for the JOH-6A/AH-6C. Neither is it feasible to reduce the helicopter gross weight capability in the mission configuration due to operational requirements.

b. Paragraph 38. This paragraph should actually refer to the torque limit of the transmission. No solution to the transmission limitation is available as there is not a higher rated military transmission and the higher rated commercial transmission would require major changes.

c. Paragraph 42. The recommendation to consider increasing the transmission torque limit to reduce pilot workload when hovering at heavy weights is valid. However, not only is there no replacement transmission available, as stated in paragraph 2.b above, but an increase in gross weight capability, which would come with an increased transmission torque limit, would cause a further reduction in the control margins when hovering with a tail wind. The existing control margins are already marginal.

DRSAV-E
SUBJECT: Directorate for Engineering Position on the Final Report of USAAEFA Project 81-04, Airworthiness and Flight Characteristics of the OH-6A Configured to a Light Combat Helicopter (JOH-6A LCH)

3. General. Despite the previously discussed transmission limit, the JOH-6A/AH-6C does have increased hover capability relative to the OH-6A, especially in hot day conditions. Other than the increased pilot workload at bank angles greater than 45 degrees, the handling qualities are essentially the same as the OH-6A. The three cautions should be included in the JOH-6A/AH-6C operators manual, as recommended.

FOR THE COMMANDER:

RONALD E. GORMONT
Acting Director of Engineering

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INTRODUCTION

BACKGROUND

1. The US Army has identified a need for a special mission helicopter that is air-transportable by C-130 aircraft. The OH-6A helicopter was selected and after modifications was designated the JOH-6A light combat helicopter (LCH). The US Army Aviation Research and Development Command (AVRADCOM) directed the US Army Aviation Engineering Flight Activity (USAAEFA) to conduct an airworthiness and flight characteristics (A&FC) test on the JOH-6A helicopter (ref 1, app A). Since the conduct of this test the aircraft has been redesignated the AH-6C.

TEST OBJECTIVES

2. The objectives of this test were to obtain limited performance and handling qualities data at the maximum allowable gross weight of the helicopter (2700 lb).

DESCRIPTION

3. The test helicopter (USA S/N 69-16054) was manufactured by Hughes Helicopters Incorporated. A major modification to the LCH configuration replaces the standard engine (T63-A-5A) with a T63-A-720 with an uninstalled sea level rating of 420 shaft horsepower (SHP) (transmission limits restricted available power to 272 SHP for takeoff). Other modifications to the standard OH-6A to configure the aircraft to a JOH-6A LCH helicopter included installation of military avionics with secure voice capability, LTN-211 Omega/VLF navigation system, one M158A1 (2.75 inch folding fin aerial rocket (FFAR) 7 tube pod) mounted on the right side and one M27E1 (7.62 minigun) armament subsystem mounted on the left side of the aircraft. Photographs of the test aircraft are presented in appendix B. A detailed description of the OH-6A is contained in the operator's manual (ref 2, app A) and a description of modifications incorporated to configure the aircraft to the JOH-6A LCH configuration are contained in the airworthiness release (ref 3) and briefly described in appendix B. A description of test instrumentation is contained in appendix C.

TEST SCOPE

4. The A&FC test was conducted at Edwards Air Force Base, Bishop, Coyote Flats and Bakersfield, California from 8 June through 10 August 1983 and consisted of 41.2 flight hours of which 34.6 were productive. Flight limitations contained in the operator's

manual and the airworthiness release were observed. General test conditions are presented in tables 1 and 2 in the Results and Discussion section. Center of gravity (cg) and airspeed limitations from the airworthiness release are presented in figures 1 and 2, appendix B.

TEST METHODOLOGY

5. Flight test techniques used are described in references 4 and 5, appendix A. Test methods and data analysis methods are briefly described in appendix D. Zero-sideslip was maintained for performance testing, while ball-centered flight was used for handling qualities tests. Handling qualities ratings were assigned in accordance with a Handling Qualities Rating Scale (HQRS) (fig. 1, app D). Data were recorded utilizing an onboard magnetic tape recording system. Control system rigging check and aircraft weight and balance were performed by USAAEFA personnel. An engine torque system calibration was performed in an engine test cell prior to testing.

RESULTS AND DISCUSSION

GENERAL

6. A limited performance, handling qualities, and vibration evaluation of the JOH-6A LCH helicopter was conducted at test sites from near sea level (488 feet) to 9980 feet at the general test conditions listed in tables 1 and 2. The JOH-6A LCH in the present configuration has limited hover performance capabilities. With the exception of the excessive pilot workload at bank angles in excess of 45 degrees, the handling qualities were essentially the same as the basic OH-6A. Vibration levels were satisfactory throughout all flight regimes tested. One deficiency attributable to the LCH configuration was identified: the excessive pilot workload to maintain aircraft control at bank angles above 45 degrees. Four shortcomings were also identified of which three were directly related to the LCH configuration.

PERFORMANCE

Hover Performance

7. The hover performance capability of the JOH-6A LCH was evaluated by determining the engine power required to hover in-ground effect (IGE) at a 2-foot skid height and out-of-ground effect (OGE) at a 50-foot skid height. Testing was accomplished at Bakersfield, California (488-foot elevation), Bishop, California (4120-foot elevation), and Coyote Flats, California (9980-foot elevation) using the free flight hover method. Summaries of the hover performance are presented in figures 1 and 2, appendix E, and nondimensional test results are presented in figures 3 and 4. Summary hover performance is based on the takeoff rated power limit of 64.5 psi torque or a turbine outlet temperature (TOT) of 810° C. A comparison of the JOH-6A LCH OGE hover ceiling to the OH-6A is shown in figure A.

8. The standard day hover performance capability of the JOH-6A LCH is limited by the main transmission to 272 shp at a main rotor speed of 483 revolutions per minute (rpm). This transmission limit prevents OGE hover on a sea level standard day at a gross weight greater than 2620 lb (mission gross weight of the JOH-6A is 2700 lb). The maximum 2-foot hover ceiling for the JOH-6A LCH at 2700 lb is 6500 feet on a 35°C hot day and over 10,000 feet on a standard day.

9. Power required for an OGE hover at a reduced mission gross weight (2600 lb) dictates operation at or near the main transmission torque limit and provides insufficient power margin for maneuvering the aircraft. Pedal movement caused torque fluctuations of up to 8 psi such that the pilot had to continually monitor

Table 1. Performance Test Conditions[1]

Type of Test	Gross Weight (lb)	Longitudinal center of gravity (FS)	Density Altitude (ft)	Trim Calibrated Airspeed (KCAS)	Remarks
Hover Performance	2310-2650	99.1 (FWD)	850-11,260	0	Free flight method skid heights: 2 ft,50 ft
Forward Flight Climb Performance	2460-2550	98.6 (FWD)	7230-8360	54-60	Sawtooth climbs
Level Flight Performance	2360-2660	98.6-99.3 (FWD)	2420-9000	31-109[2]	Constant weight to density ratio method
Autorotational Descent Performance	2450-2540	98.7-99.1 (FWD)	7300-7690	36-74	Rotor speeds varied from 407 to 512 rpm

NOTES:

[1]Tests were conducted with doors off at zero sideslip, mid lateral center of gravity, and normal rotor speed (483 rpm) except as noted above.
[2]Knots true airspeed

Table 2. Handling Qualities Test Conditions[1]

Type of Test	Gross Weight (lb)	Longitudinal Center of Gravity (FS)	Density Altitude (ft)	Trim Calibrated Airspeed (KCAS)	Remarks
Control Positions in Trimmed Forward Flight	2360-2660	98.6-99.2(FWD)	2420-9000	29-105	Level flight, climb and autorotation
Static Longitudinal Stability	2620-2690	100.0 (FWD)	6880-7980	36-82	Level flight, climb and autorotation
Static Lateral-Directional Stability	2540-2640	100.0-100.5(FWD)	6570-8970	56-79	Level flight, climb and autorotation
Maneuvering Stability	2570-2610	100.0-100.3(FWD)	6980-7440	59-76	Left and right steady turns, symmetrical pullups and pushovers
Dynamic Stability	2400-2700	99.1-99.7(FWD)	1270-7800	0-75	Hover and level flight
Controllability	2460-2670	99.1-99.7(FWD)	1240-7000	0-69	Hover and level flight
Simulated Engine Failures	2600-2650	99.7 (FWD)	6470-8420	60-76	Level flight and climb
Low Speed Flight	2600-2680	99.1-99.3(FWD)	1220-6180	Sideward: 0-35 KTAS[2] Rearward: 0-30 KTAS Forward: 0-37 KTAS	Skid height 5 ft Mid and extreme Right lateral cg (BL 2.2)
Dynamic System/ Engine Compatibility	2600-2640	99.1 (FWD)	4880-4990	0	Rotor speed varied from 411 to 484 on the ground and at a hover

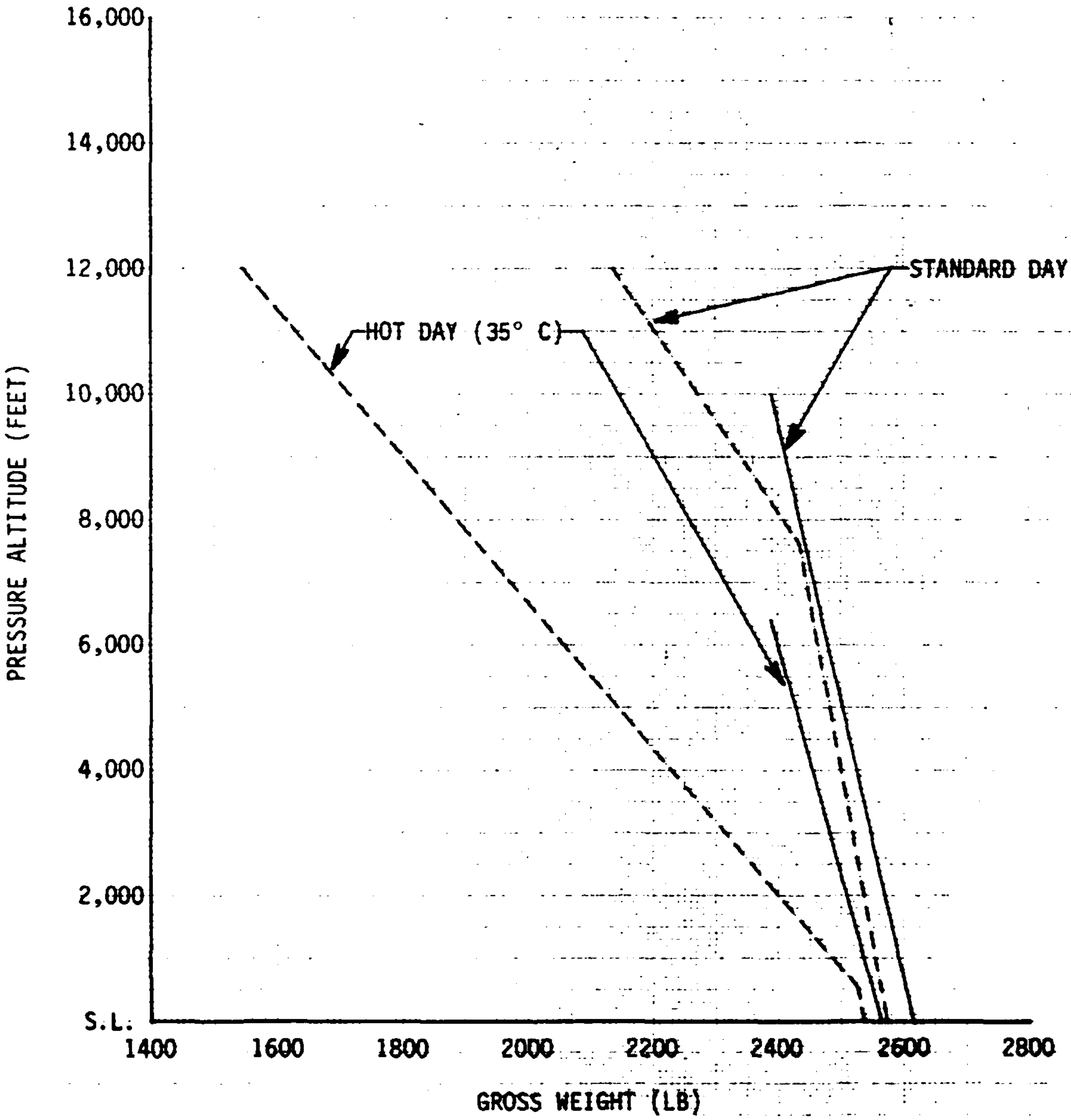
NOTES:

[1]Tests were conducted with doors off in ball-centered flight and mid lateral center of gravity
[2]Knots true airspeed

FIGURE A
OUT OF GROUND EFFECT HOVER CEILING COMPARISON
TAKEOFF RATED POWER
483 RPM

DASHED LINES - STANDARD OH-6A
SOLID LINES - JOH-6A LCH

NOTES: 1. OH-6A TRANSMISSION LIMITED TO 260 SHP
2. JOH-6A LCH TRANSMISSION LIMITED TO 272 SHP



the torque gauge and limit directional control movement to prevent exceeding transmission torque limitations. High pilot workload to prevent a transmission overtorque condition due to transients associated with pedal movement is a shortcoming. The following caution should be placed in the operator's manual for the LCH configuration.

CAUTION

> Inadvertent transmission overtorque due to torque transients associated with pedal movement may occur when hovering at high gross weights.

Consideration should be given to increasing the existing transmission torque limitations to provide better hover performance.

Forward Flight Climb Performance

10. The forward flight climb performance of the JOH-6A LCH was evaluated using the sawtooth climb technique at a constant rotor speed of 483 rpm. Summaries of the forward flight climb performance and the climb airspeed schedules are presented in figures 5 and 6, appendix E. Generalized climb test data are presented in figure 7.

11. The maximum rate of climb at sea level, standard day conditions at 2700 pounds gross weight and best climb airspeed (53 knots calibrated airspeed (KCAS)) was determined to be 1124 ft/min and was limited by the main transmission limit (272 shp). At the same gross weight, for standard day conditions at 10,000 feet and best climb airspeed (49 KCAS), the JOH-6A LCH has over 900 ft/min rate of climb capability.

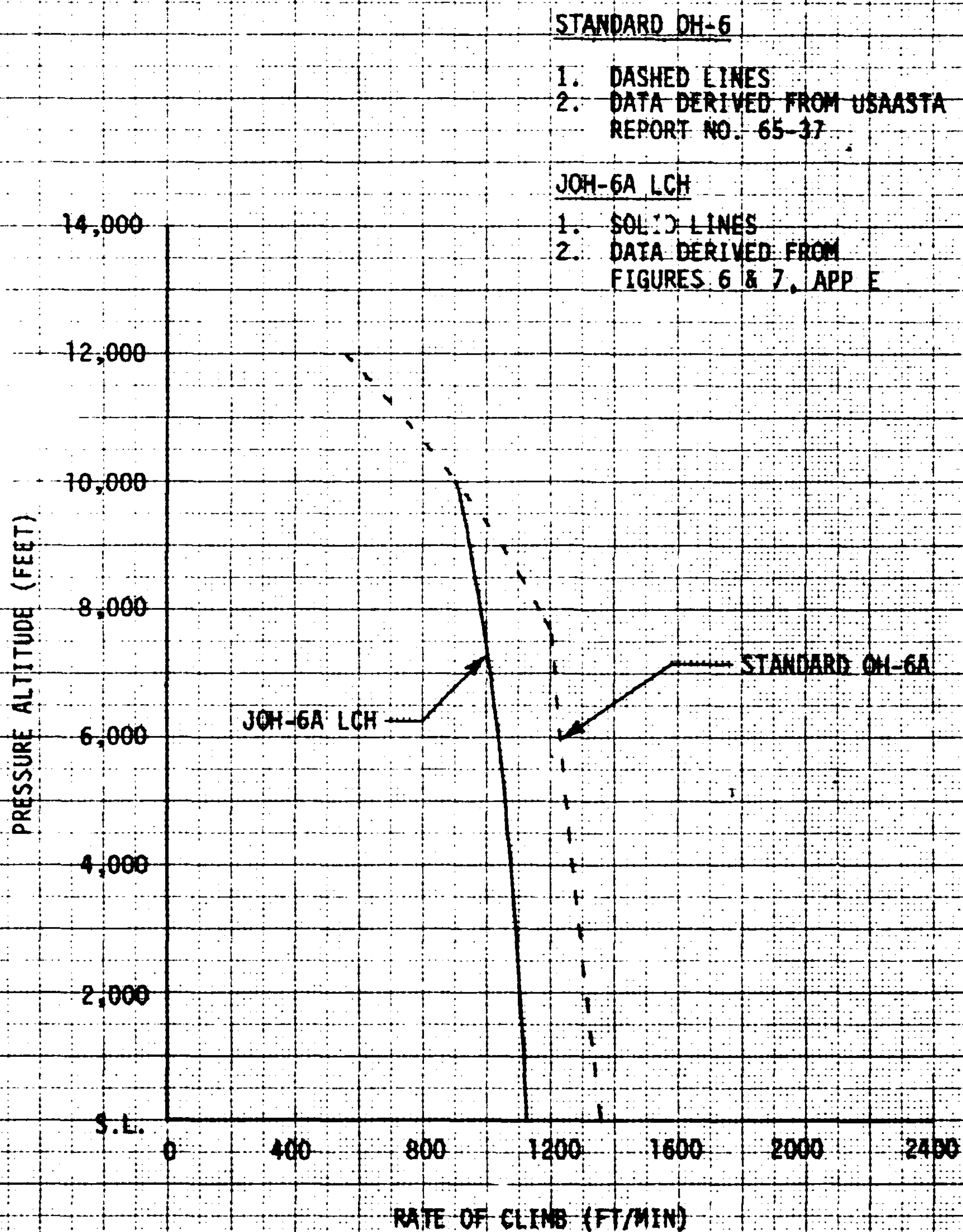
12. The power correction factor, K_P, was determined from figure 9 to be 0.75 for climb performance calculations. This compares to 0.8145 for the OH-6A (ref 6, app A). Figure B presents a comparison of the JOH-6A LCH climb performance with that of the OH-6A.

Level Flight Performance

13. Level flight performance tests were conducted to determine power required as a function of airspeed, gross weight, and density altitude. The constant gross weight to density ratio (w/σ) method was used. Data were obtained in zero-sideslip stabilized level flight at incremental airspeeds ranging from approximately 30 KCAS to maximum airspeed for level flight (V_h) or never exceed airspeed (V_{NE}), whichever occurred first. Results of these tests are presented nondimensionally in figures 8

FIGURE B
CLIMB PERFORMANCE COMPARISON

TAKEOFF RATED POWER
STANDARD DAY
GROSS WEIGHT - 2700 LB , ROTOR SPEED - 483 RPM



and 9, appendix E, dimensionally in figures 10 through 14. Range and endurance summaries are presented in figures 15 and 16.

14. Figure C shows comparison data for the standard OH-6A, an OH-6A armed with the XM27E1 armament subsystem (ref 7, app A), and the JOH-6A in the LCH configuration. The specific conditions for this comparison are 2700 pounds gross weight, sea level standard day. Test results show that the JOH-6A LCH has increased power required and decreased specific range when compared to the standard OH-6A. For example, from figure C, at 70 knots true airspeed (KTAS), the JOH-6A LCH required an additional 25 shp and the specific range decreased by 16%. At 105 KTAS (V_{NE} of the JOH-6A LCH), the specific range of the JOH-6A was decreased by 31%.

15. The maximum range cruise true airspeed of the JOH-6A LCH, as defined by 99 percent of the maximum specific range, was determined to be in excess of V_{NE}. Therefore, the cruise airspeed is limited to V_{NE} and the range summary shown in figure 15, appendix E was computed on this basis.

Autorotational Descent Performance

16. The autorotational descent performance of the JOH-6A LCH was evaluated to determine the airspeed for minimum rate of descent ($V_{min\ R/D}$), the optimum airspeed for maximum glide distance ($V_{max\ glide}$), and the rotor speed for minimum rate of descent. Data are presented in figures 17 and 18, appendix E. The optimum airspeed for maximum glide distance was 66 KCAS at a rotor speed of 485 rpm resulting in a rate of descent of 1840 fpm. Minimum rate of descent was 1680 fpm and occurred at 47 KCAS at a rotor speed of 485 rpm.

HANDLING QUALITIES

Control Positions in Trimmed Forward Flight

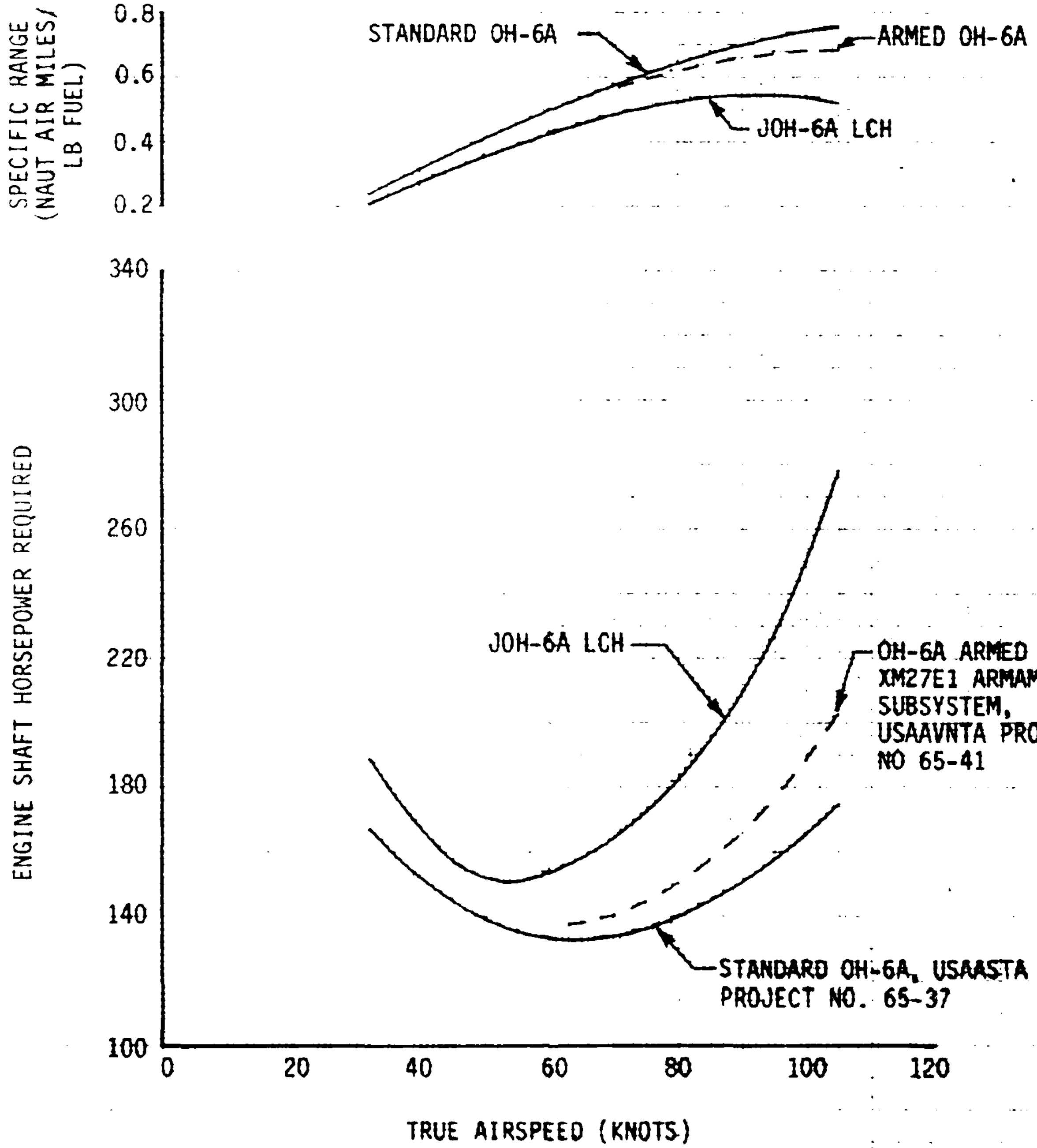
17. The control positions of the JOH-6A LCH in trimmed forward flight were evaluated in conjunction with level flight, climb, and autorotational descent performance testing. The test results are presented in figures 19 through 24, appendix E.

18. During both level flight and maximum power climbs, increasing forward longitudinal control trim positions were required at increased forward speeds. Trim control position variations with airspeed showed no discontinuity, and adequate control margins were available. During climbs at maximum power, a noticeable increase in right pedal with increasing airspeed was observed

FIGURE C
LEVEL FLIGHT PERFORMANCE COMPARISON
JOH-6A LCH (AH-6C) USA S/N 69-16054

GROSS WEIGHT (LB)	LONGITUDINAL CG LOCATION (FS)	PRESSURE ALTITUDE (FT)	OAT (°C)	ROTOR SPEED (RPM)	C_T
2700	99.2 (FWD)	SEA LEVEL	15.0	483	0.004698

NOTES: 1. ZERO SIDESLIP
2. CONFIGURATION: STD OH-6A - DOORS ON
JOH-6A LCH - DOORS OFF, ARMED



but was not excessive. During level flight, little change in longitudinal control position (1/2 inch) was required as airspeed increased from 50 to 70 KCAS and the pilot workload to maintain a constant airspeed (±1 knot) within that range increased (HQRS 4) as compared to the workload required at airspeeds above 70 KCAS (HQRS 3). Pitch attitude varied from 1 degree nose up at 30 KCAS to 6 degrees nose down at maximum level flight airspeed. There was a large longitudinal control trim shift with collective position (4 inches) between climbing flight and autorotation at the same airspeed. Any collective control movement required a longitudinal cyclic change to maintain pitch attitude. The control positions in trimmed forward flight of the JOH-6A LCH were essentially unchanged from those of the OH-6A (ref 6, app A).

Static Longitudinal Stability

19. The static longitudinal stability characteristics of the JOH-6A LCH were evaluated in climbs, autorotational descents and level flight at the conditions presented in table 2, and data are presented in figures 25 through 28, appendix E. The variation of longitudinal control position with airspeed was essentially linear and indicated weak positive static stability (forward control displacement and an accompanying push force for higher airspeeds). The average gradient about level flight trim was 60 KCAS per 1 inch of displacement. This shallow gradient required increased pilot workload to establish and maintain a desired airspeed and resulted in a ±3 knot airspeed excursion when trying to maintain 60 KCAS (HQRS 3). The static longitudinal stability characteristics of the JOH-6A LCH are essentially unchanged from the OH-6A (ref 6, app A).

Static Lateral-Directional Stability

20. Static lateral-directional stability characteristics of the JOH-6A LCH were evaluated in climbs, autorotational descents and level flight at the conditions presented in table 2, and data are presented in figures 29 through 32, appendix E. At both 59 and 79 KCAS the helicopter exhibited positive directional stability (increased left directional control for increase in right sideslip), and positive dihedral effect (increased right lateral control with increased right sideslip). The gradient of directional control position with change in sideslip angle was approximately 12 degrees of sideslip angle per 1 inch of pedal displacement at 59 KCAS level flight and was slightly steeper (7 degrees of sideslip angle per 1 inch of pedal displacement) at 79 KCAS. Sideforce cues were weak about trim at these airspeeds as evidenced by the small change in roll attitude with sideslip. The static lateral-directional stability characteristics of the JOH-6A LCH are essentially unchanged from those of the OH-6A (ref 6, app A).

Maneuvering Stability

21. Maneuvering stability was evaluated in left and right steady turns, and during symmetrical pullups and pushovers, and the data are presented in figures 33 through 36, appendix E. A time history of control positions and rates for an attempt to stablize in a right bank of 50 degrees is presented in figure 37. The stick-fixed maneuvering stability in steady state turns as indicated by the variation of longitudinal control position with normal acceleration (g) was positive. The stick-fixed maneuvering stability gradient decreased as the airspeed increased in both left and right turns. Lateral control trim changes with load factor were less at the higher airspeeds. Blade stall was characterized by increased aircraft vibration, longitudinal control feedback, and very high down forces on the collective control. The onset of blade stall for one weight/altitude combination is shown in figure D. At higher gross weights (2700 pounds), the onset of pitch instability and blade stall occurred at lower g levels. Bank angles above 45 degrees were impossible to maintain within ±5 degrees due to pitch, roll and yaw excursions caused by the onset of blade stall. In fact, ±2 inches of longitudinal and lateral control movement was required just to maintain airspeeds within ±7 knots of trim and bank angles within ±10 degrees (HQRS 7). The pilot workload was less at 55 KCAS than at 70 KCAS but was still excessive. The excessive pilot workload to maintain aircraft control at bank angles above 45 degrees at maximum gross weight is a deficiency attributable to the LCH configuration.

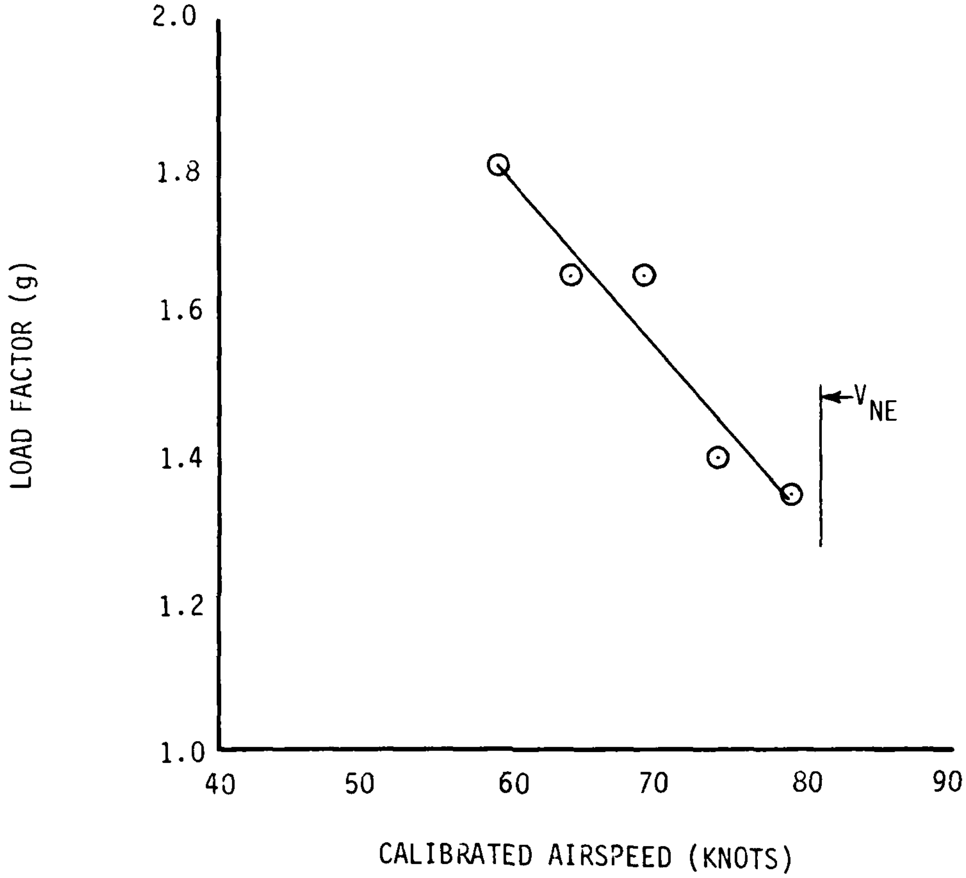
Dynamic Stability

22. Dynamic stability (figs. 38 through 40) was evaluated during hover, level flight, climbs, and descents at the conditions shown in table 2. Short-term dynamic stability characteristics for longitudinal, lateral and directional controls were evaluated following single-axis, 1/2 second, 1 inch pulse inputs and during 1 inch control doublets. Following the inputs all controls were held fixed until the aircraft motion subsided or until recovery became necessary. Long-term longitudinal dynamic stability characteristics were also evaluated.

23. The response of the JOH-6A aircraft to a pedal doublet is presented in figure 38, appendix E. At heavy gross weights, an easily excited but damped dutch roll (2.5 second period) developed during all flight conditions. The dutch roll response was more pronounced during maximum power climbs at 61 KCAS (fig. 39, app E). The dutch roll mode was more damped at the higher airspeed (79 KCAS) tested and was less easily excited. The short period

FIGURE D
BLADE STALL ONSET
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG LOCATION (FS)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)
2530	100.3(FWD)	6940	27.0	483



dynamic stability characteristics of the JOH-6A LCH are similar to those of the standard OH-6A (ref 6, app A).

24. The aircraft longitudinal long-term response at 60 KCAS was self-excited during climb and diverged to an attitude requiring recovery in approximately 30 seconds (fig. 40, app E). During level flight, the long-term had to be excited (gust or longitudinal pulse) before the pitch divergence occurred. The pitch instability was more pronounced at higher power settings and less pronounced at higher airspeeds. The dutch roll mode discussed in paragraph 23 aggravated the pitch divergence which then became the predominent aircraft response. These pitch oscillations required continual longitudinal cyclic inputs (±1/2 inch) to maintain airspeed within ±3 knots which increased pilot workload (HQRS 4). The divergent long-term longitudinal pitch response of the JOH-6A LCH is a shortcoming.

Controllability

25. Forward flight longitudinal, lateral and directional controllability tests were conducted during level flight at 55 and 75 KCAS. Control response and sensitivity data are shown in figures 41 through 43, appendix E. The rates and accelerations were linear with respect to the control input magnitude. Longitudinal control response at 75 KCAS for aft step inputs greater than 1 inch could not be achieved. Premature recovery from these inputs was necessary prior to attaining the maximum pitch rate due to the onset of blade stall. The aircraft was responsive in all axes with no tendency to overcontrol. Forward flight longitudinal, lateral and directional controllability was essentially unchanged from the OH-6A.

26. Control response at a hover was evaluated with a gross weight of 2460 lb at the conditions shown in table 2. Directional control response and sensitivity data are shown in figure 44, appendix E. The rates and accelerations were linear with respect to the control input magnitude. Longitudinal and lateral response was predictable with no tendency to overcontrol. Right directional inputs produced yaw rates which developed more quickly than to the left and allowed less time for recovery. Right pedal step inputs of approximately 1 inch generated yaw rates of 70 deg/sec after 1 second. Due to the insufficient power margin discussed in paragraph 9, recovery from right directional step inputs required constant attention to torque limits with large (±3 inches) but smooth control movement required to arrest right yaw rate while preventing transmission overtorques.

Low Speed Flight Characteristics

27. The low speed flight characteristics of the JOH-6A LCH were evaluated using a calibrated ground pace vehicle as a speed reference. Surface wind conditions were less than 5 knots and skid height was approximately 5 feet. Flights were accomplished at a gross weight of approximately 2700 pounds and at two lateral cg locations. These lateral cg locations represented a symmetrical ordnance loading configuration (BL 0.5 Rt) and a worst case asymmetrical loading configuration of 7 rockets in the rocket pod and machine gun empty (BL 2.2 Rt). Data were obtained under the conditions listed in table 2.

Forward and Rearward Flight:

28. Control positions in low speed forward and rearward flight are presented in figures 45 through 48, appendix E. Low speed forward flight was easily accomplished and the handling qualities were essentially unchanged for both loading configurations. Control inputs of 1 to 2 inches were required to maintain 15 KTAS during rearward flight for both loading configurations. Adequate control margins were available in all axes during forward flight, however, less than 10% longitudinal control margin existed at rearward speeds in excess of 15 KTAS. The following caution should be included in the operator's manual for the LCH configuration.

CAUTION

> When operating at the forward center of gravity, less than 10% aft longitudinal control margin may exist with wind/flight speed combinations in excess of 15 knots from the left rear quadrant.

Sideward Flight:

29. During sideward flight with either loading configuration (figs. 49 and 52, app E), increasing lateral cyclic was required in the direction of flight up to 30 KTAS in either direction. Increasing left directional control in right sideward flight and right directional control in left sideward flight were required throughout the speed range. As much as 2 inches of aft longitudinal control was required during left sideward flight from 10 to 30 KTAS. No longitudinal control position trim shift occurred in right sideward flight up to 30 KTAS. It was more difficult to stabilize the aircraft in left sideward flight than in right sideward flight. If a yaw of 20 to 30 degrees developed in right sideward flight at 10 to 20 KTAS, approximately 90 percent left

pedal was required to prevent the aircraft from weathervaning into the relative wind. Less than 10% aft longitudinal control margin existed during left sideward flight at speeds in excess of 15 KTAS (see para 28). The task of stabilizing in left and right sideward flight within the 10 to 20 KTAS range was very difficult due to random pitch, roll and yaw excursions ($\pm$3 degrees). These excursions required rapid control movements of $\pm$1 inch to maintain aircraft directional control (HQRS 6). This instability occurred with both loading configurations in both left and right sideward flight. The random pitch, roll and yaw excursions during left and right sideward flight (essentially unchanged from a standard OH-6A) between 10 and 20 KTAS are a shortcoming. The following caution should be included in the operator's manual for the LCH configuration.

CAUTION

> Large and rapid control movements may be required to maintain aircraft control during left or right sideward flight or when hovering in left or right crosswinds of 10 to 20 knots.

Critical Azimuth:

30. Flights in both loading configurations were flown in 45 degree increments of relative wind to determine critical azimuth. The data are presented in figures 53 through 58, appendix E. Critical azimuth, as determined by maximum pilot workload, was 225 degrees relative to the nose of the aircraft as measured in a clockwise direction. Less than 10% longitudinal aft control margin existed during the 225 degree relative azimuth at speeds in excess of 15 KTAS (see para 28). Pilot workload to maintain heading within $\pm$5 degrees increased up to 20 KTAS (HQRS 5). Between 20 and 30 KTAS, although the magnitude of control movement continued to increase, the reduced frequency of control movement resulted in reduced pilot workload (HQRS 4).

Simulated Engine Failures

31. Simulated engine failures were evaluated in level flight and during climbs at the conditions presented in table 2. Time histories are presented in figures 59 through 62, appendix E. All controls were held fixed following throttle reduction until minimum transient rotor speed (400 rpm) dictated recovery. The initial aircraft response was an immediate yaw to the left, followed closely by a slow left roll and a very slight pitch up. A high (greater than 30 rpm/sec) rate of rotor decay prior to

reducing collective resulted. Once the collective was lowered, the nose pitched down and rotor decay was immediately arrested. The time available for pilot recognition and reaction to sudden engine failure (delay time) was determined for all test conditions. Delay times for level flight and maximum power climbs averaged 1.5 seconds at both 60 KCAS and 75 KCAS. The delay times were slightly less than those of the standard OH-6A (ref 6, app A).

32. Recovery techniques following simulated engine failures were similar for all conditions with rapid lowering of collective followed by application of right lateral cyclic (3 to 4 inches) and right pedal (0.5 inches). Lowering the collective control also resulted in a rapid nose down pitch rate which required an immediate aft cyclic input (5 to 6 inches). At the high gross weights tested, full down collective resulted in a rapid buildup of rotor speed. This rapid buildup of rotor speed required considerable pilot attention to prevent exceeding rotor rpm limits during the initial entry phase of the autorotation (HQRS 5). Once in stabilized autorotation collective pitch had to be continually adjusted to maintain the desired rotor speed since small variations in airspeed or attitude resulted in large variations in rotor speed. The high pilot workload required to establish a stabilized autorotation following an engine failure at mission gross weight is a shortcoming.

Vibration

33. The vibration characteristics of the JOH-6A LCH were qualitatively evaluated during all flights. During hover and forward flight the helicopter was noticeably free of vibrations and the pilot was not distracted from his primary mission or flight tasks due to aircraft vibration. Vibration levels for the JOH-6A LCH are satisfactory.

Airspeed Calibration

34. The airspeed system for the JOH-6A LCH was calibrated using the trailing bomb method. The ship's system airspeed calibrations in level flight, climbs, and autorotation are presented in figures 63 through 68, appendix E. An infrared (IR) search light installed near the pitot tube affected the airspeed indicating system. Besides the standard pitot tube, an extended pitot tube was evaluated (photo 9, app B). The extended pitot tube was found to be the more accurate system for airspeed determination.

Dynamic System/Engine Compatibility

35. The dynamic system/engine compatibility was evaluated in accordance with reference 8, appendix A except as modified by reference 3. Critical input frequency was determined as the frequency of collective cycling which caused maximum engine torque fluctuations. Tests were conducted at the conditions shown in table 1. All oscillations damped out within 1 to 2 cycles cycles after stopping collective excitation. Engine and helicopter response was highly damped.

CONCLUSIONS

GENERAL

36. The following general conclusions were reached:

a. The JOH-6A LCH in the present configuration has limited hover performance capabilities.

b. With the exception of the excessive pilot workload at bank angles in excess of 45 degrees, the handling qualities were essentially the same as the basic OH-6A.

c. The extended pitot tube was more accurate than the standard tube for airspeed determination.

DEFICIENCY

37. The following deficiency was identified: The excessive pilot workload to maintain aircraft control at bank angle above 45 degrees at maximum gross weight (para 21).

SHORTCOMINGS

38. The following shortcomings were identified:

a. the high pilot workload to prevent an engine overtorque in a hover (para 9)

b. the divergent long-term longitudinal pitch response (para 24)

c. the random pitch, roll and yaw excursions during left and right sideward flight between 10 and 20 knots (para 29)

d. The high pilot workload to establish a stabilized autorotation following an engine failure at mission gross weight (para 32)

RECOMMENDATIONS

39. Correct the deficiency listed in paragraph 37.

40. Correct the shortcomings listed in paragraph 38.

41. The following cautions should be placed in the operator's manual for the LCH configuration (paras 9, 28 and 29).

CAUTION

Inadvertent transmission overtorque due to torque transients associated with pedal movement may occur when hovering at high gross weights.

CAUTION

When operating at the forward center of gravity, less than 10% longitudinal aft control margin may exist with wind/flight speed combinations in excess of 15 knots from the left rear quadrant.

CAUTION

Large and rapid control movements may be required to maintain aircraft control during left or right sideward flight or when hovering in left or right crosswinds of 10 to 20 knots.

42. Consideration should be given to increasing the existing transmission torque limitations to provide better hover performance.

APPENDIX A. REFERENCES

1. Letter, AVRADCOM, DRDAV-DI, 16 April 1981, subject: Airworthiness and Flight Characteristics Test of OH-6A Configured to a Light Combat Helicopter (LCH). (Test Request)

2. Operator's Manual, TM 55-1520-214-10, *Helicopter Observation OH-6A*, 17 December 1976 through change 11, 11 January 1982.

3. Letter, AVRADCOM, DRDAV-D, 16 May 1983, subject: Airworthiness Release for Flight Operation of the JOH-6A Aircraft (69-16054), USAAEFA Project 81-04.

4. Pamphlet, Army Material Command, AMCP 706-204, *Engineering Design Handbook, Helicopter Performance Testing*, 1 August 1974.

5. Flight Test Manual, Naval Air Test Center, FTM No. 101, *Stability and Control*, 10 June 1968.

6. Final Report, USAASTA, Project No. 65-37, *Engineering Flight Test of the OH-6A Helicopter (Cayuse)*, April 1969.

7. Final Report, USAAVNTA, Project No. 65-41, *Engineering Flight Test (Product Improvement Test) of Production OH-6A Helicopter Unarmed and Armed with the XM-27E1 Weapon System*, February 1968.

8. Engineering Design Handbook, Army Material Command, AMC Pamphlet 706-203, *Helicopter Performance Testing*, April 1972.

9. Technical Manual, TM 55-2840-241-23, *Engine Aircraft, Gas Turbine Model T63-A-720*, 2 November 1977 through change 8, 8 November 1982.

APPENDIX B. DESCRIPTION

GENERAL

1. The JOH-6A (S/N 69-16054) light combat helicopter (LCH) test aircraft was a standard aircraft in accordance with Hughes Helicopter detail specification HTC-A369-V-8003A and the operator's manual except for LCH modifications and test instrumentation installation (photos 1 through 10). A detailed description of the standard OH-6A is presented in reference 2, appendix A. Modifications to the LCH configuration are presented in reference 3. All mission equipment modifications, except the radar altimeter, included external components only, with no internal wiring or instruments installed. The longitudinal center of gravity (cg) and airspeed envelopes as modified by reference 3 are shown in figures 1 and 2.

HELICOPTER OBSERVATION OH-6A

2. The OH-6A aircraft is a four place, dual control, single engine observation helicopter. It incorporates a single 4-bladed main rotor, a 2-bladed tail rotor and an oleo-damped skid-type landing gear. The main rotor is fully articulated while the tail rotor is semi-rigid. The aircraft is powered by a single free turbine, turboshaft engine mounted in the aft fuselage section directly behind the cargo compartment.

3. The standard OH-6A is equipped with a T63-A-5A or T63-A-700 turbine engine. One LCH modification replaces the standard engine with a T63-A-720 with an uninstalled, sea level rating of 420 shaft horsepower (SHP). The transmission limits restrict available power to 272 SHP for takeoff. A detailed description of the T63-A-720 engine is presented in TM55-2840-241-23 (ref 9, app A).

DIMENSIONAL DATA

4. Primary dimensional data is presented in figures 3 and 4.

JOH-6A (S/N 69-16054) Modifications

5. Modifications to the OH-6A to create the JOH-6A (redesignated AH-6C) are detailed in the airworthiness release (ref 3, app A). Modifications applicable to the test aircraft are described below:

a. Crew station:

1) The AN/ARC 51 VHF radio, AN/ARN-89 ADF radio and the AN/APX 72 transponder were removed.

Photo 1. JOH-6A Light Combat Helicopter

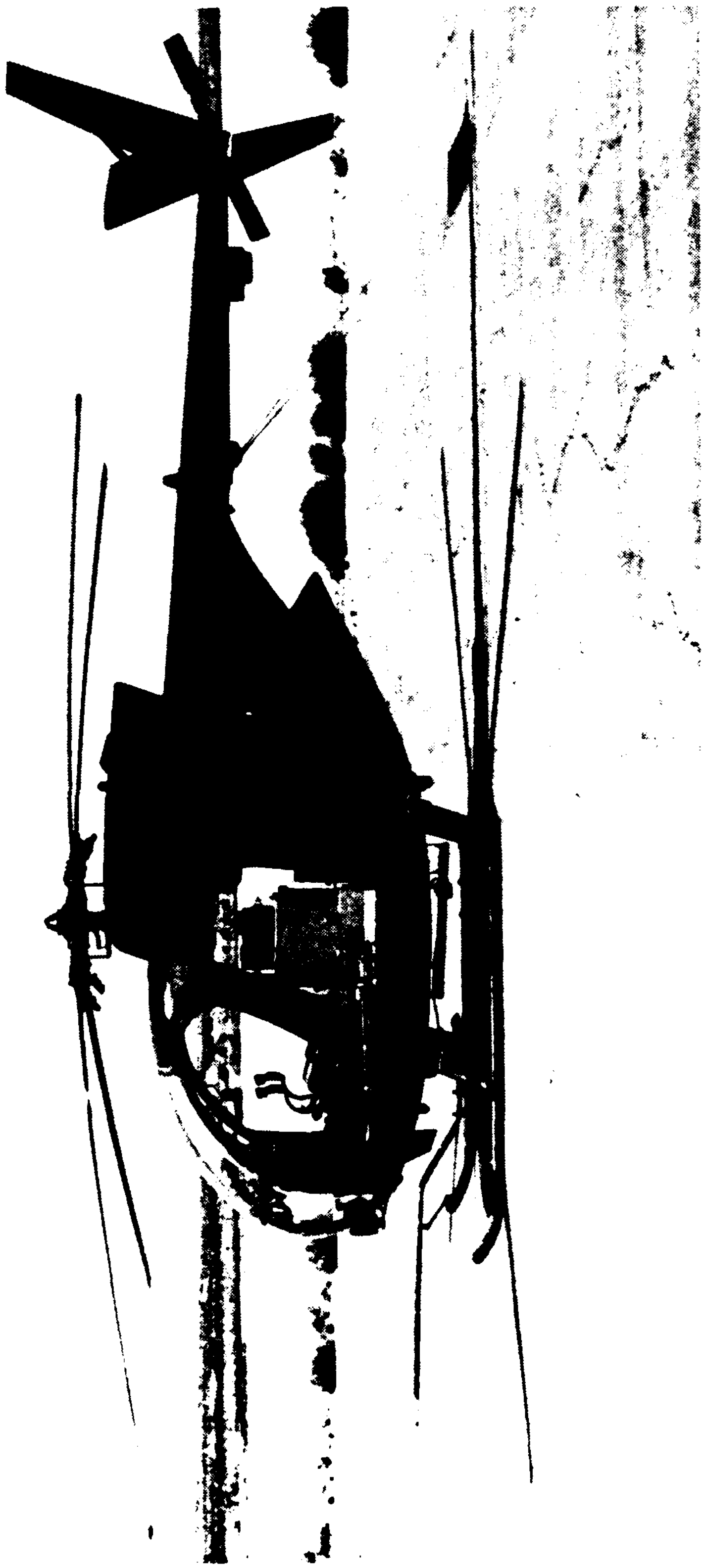


Photo 2. JOH-6A Light Combat Helicopter

Photo 3. JOH-6A Light Combat Helicopter

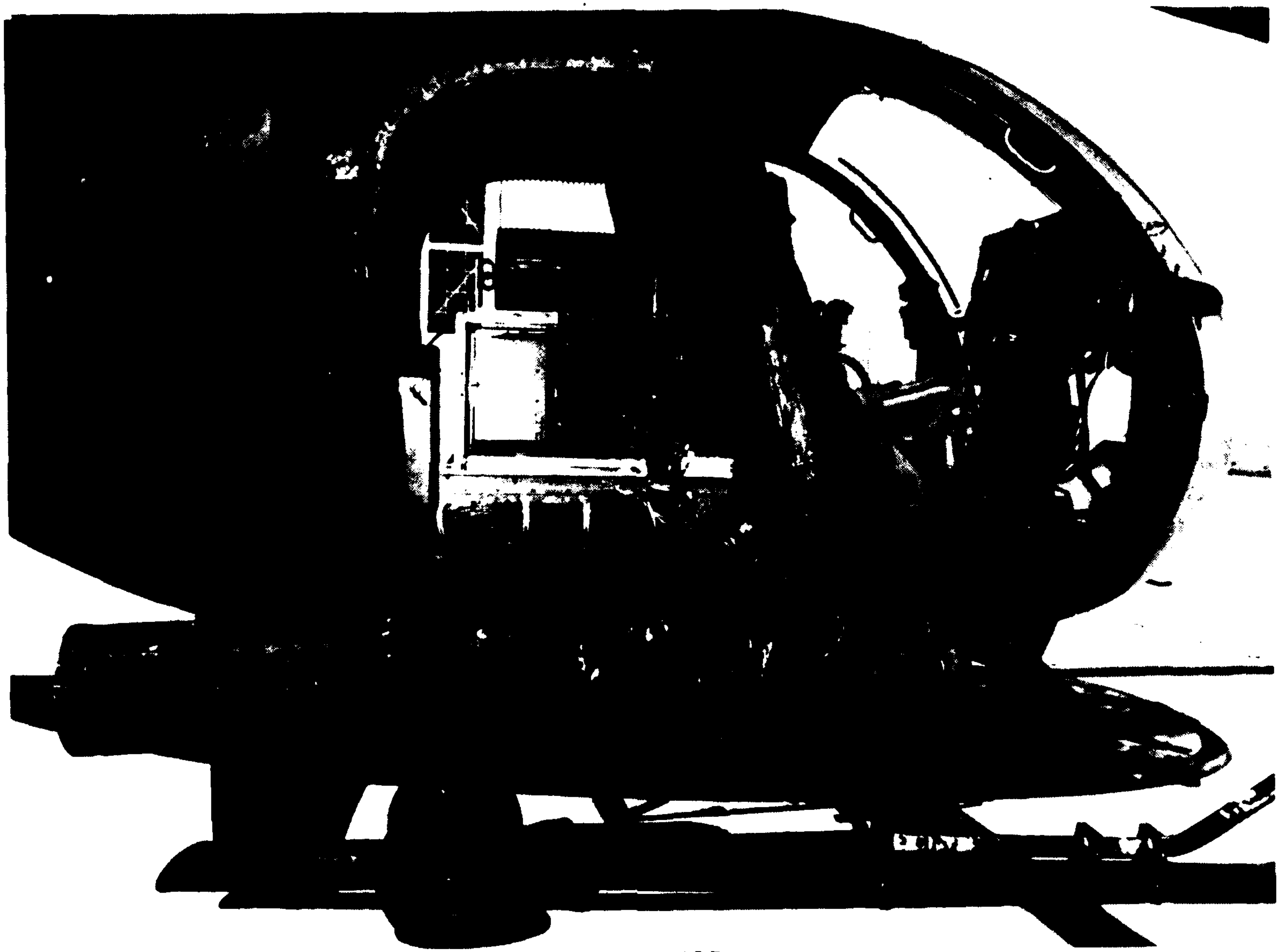


Photo 4. 2.75-Inch FFAR Armament System

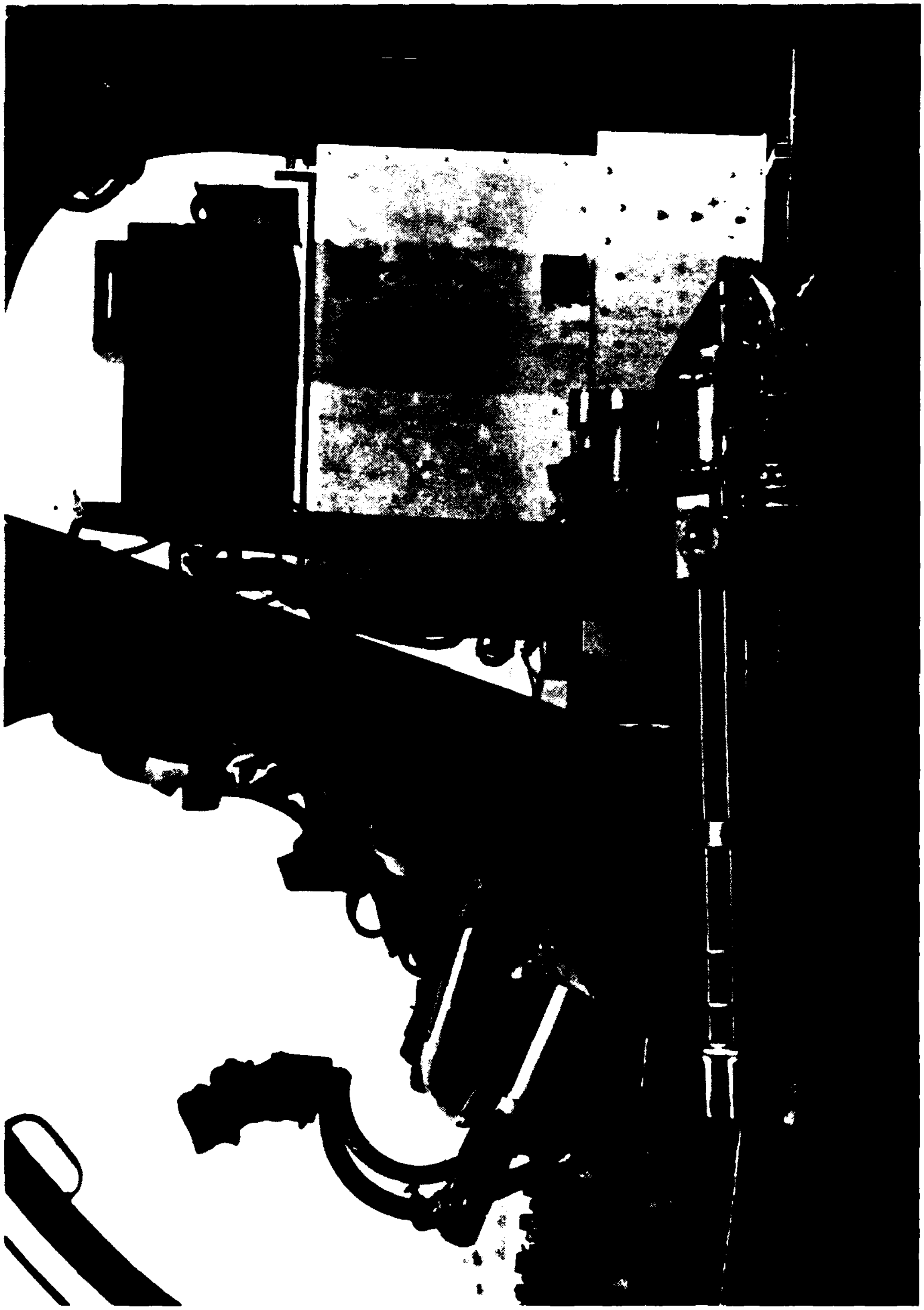


Photo 5. M27E1 (7.62 Minigun) Armament System

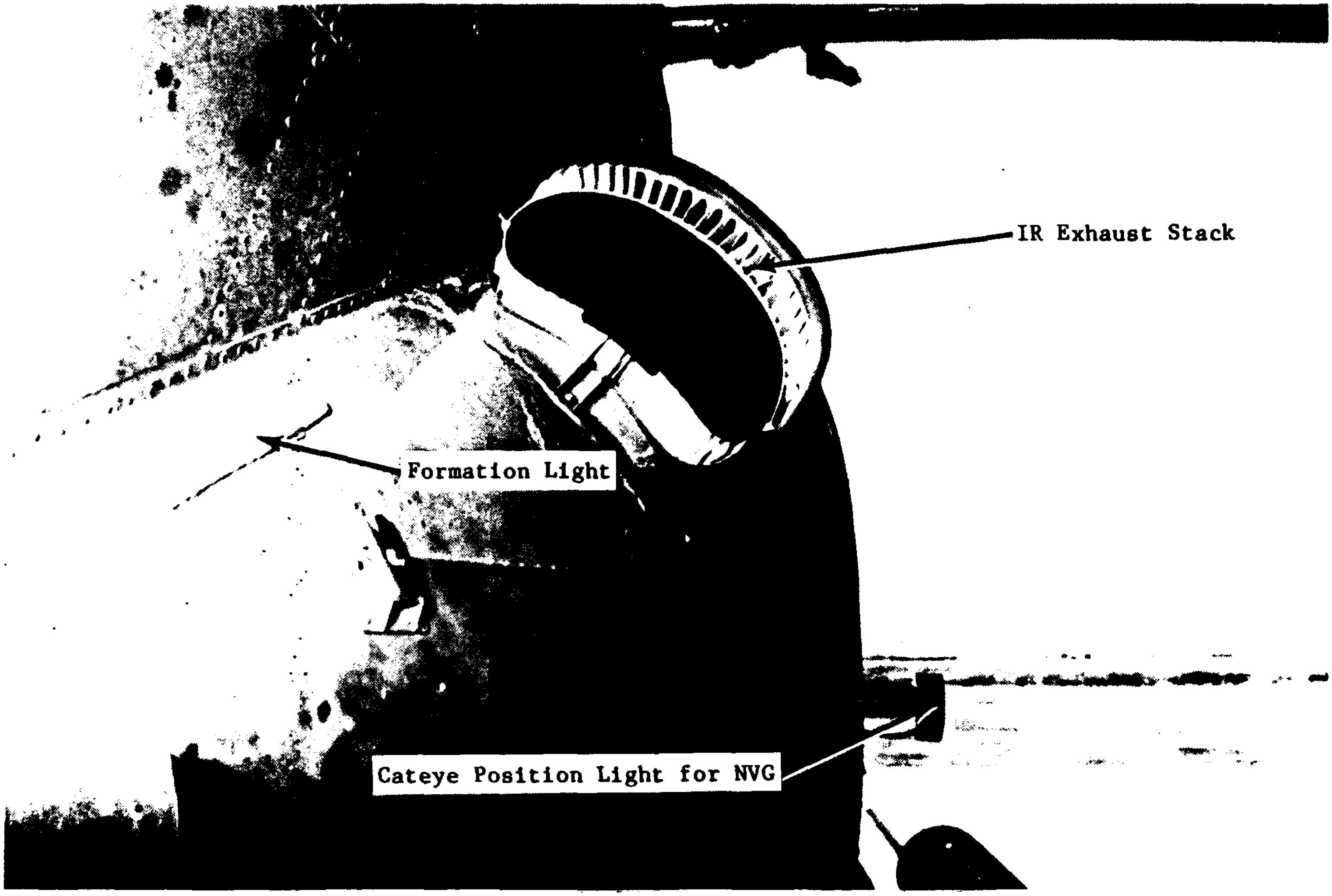


Photo 6. Right Rear External Modifications

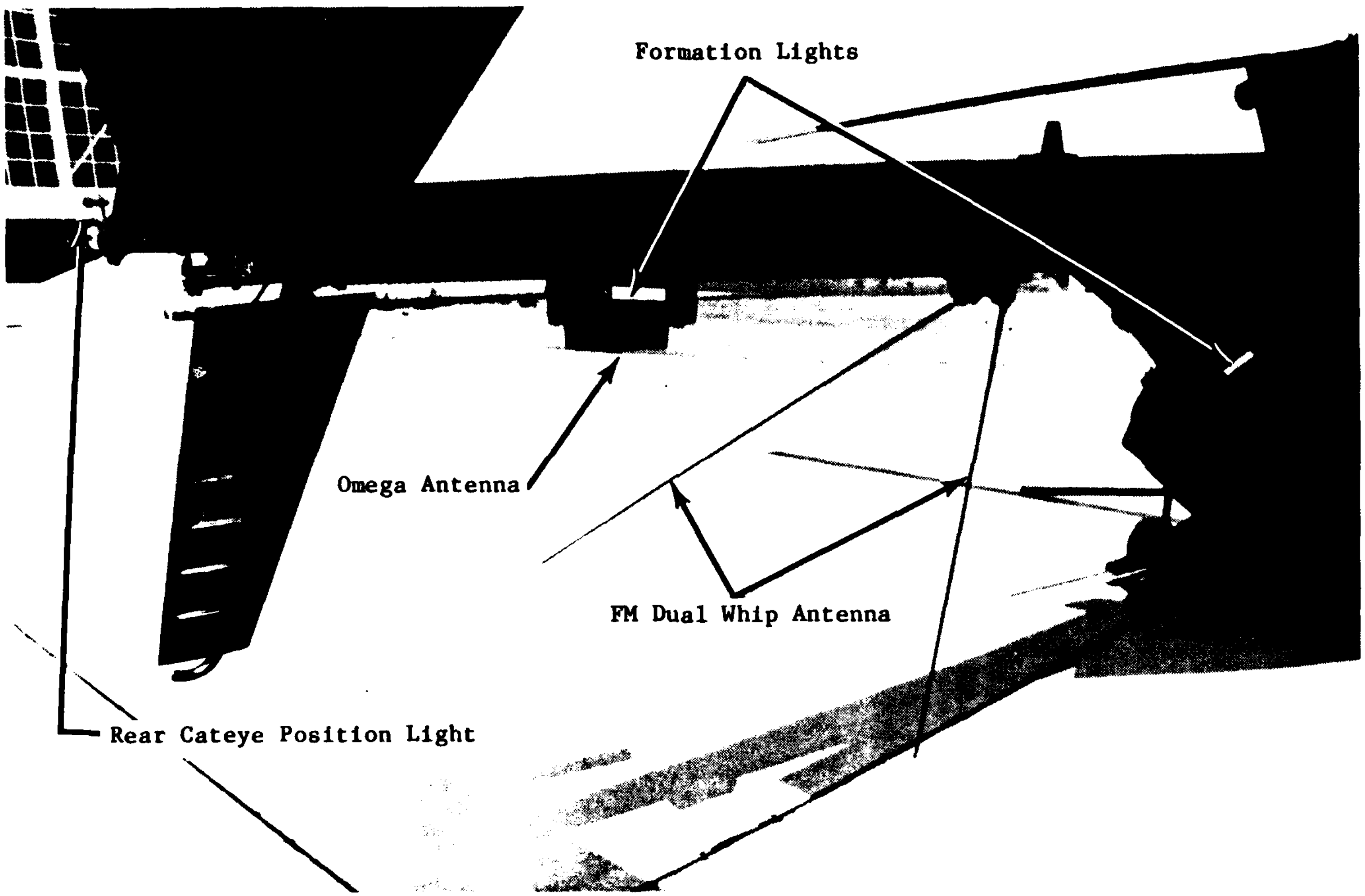


Photo 7. Tail Boom External Modifications

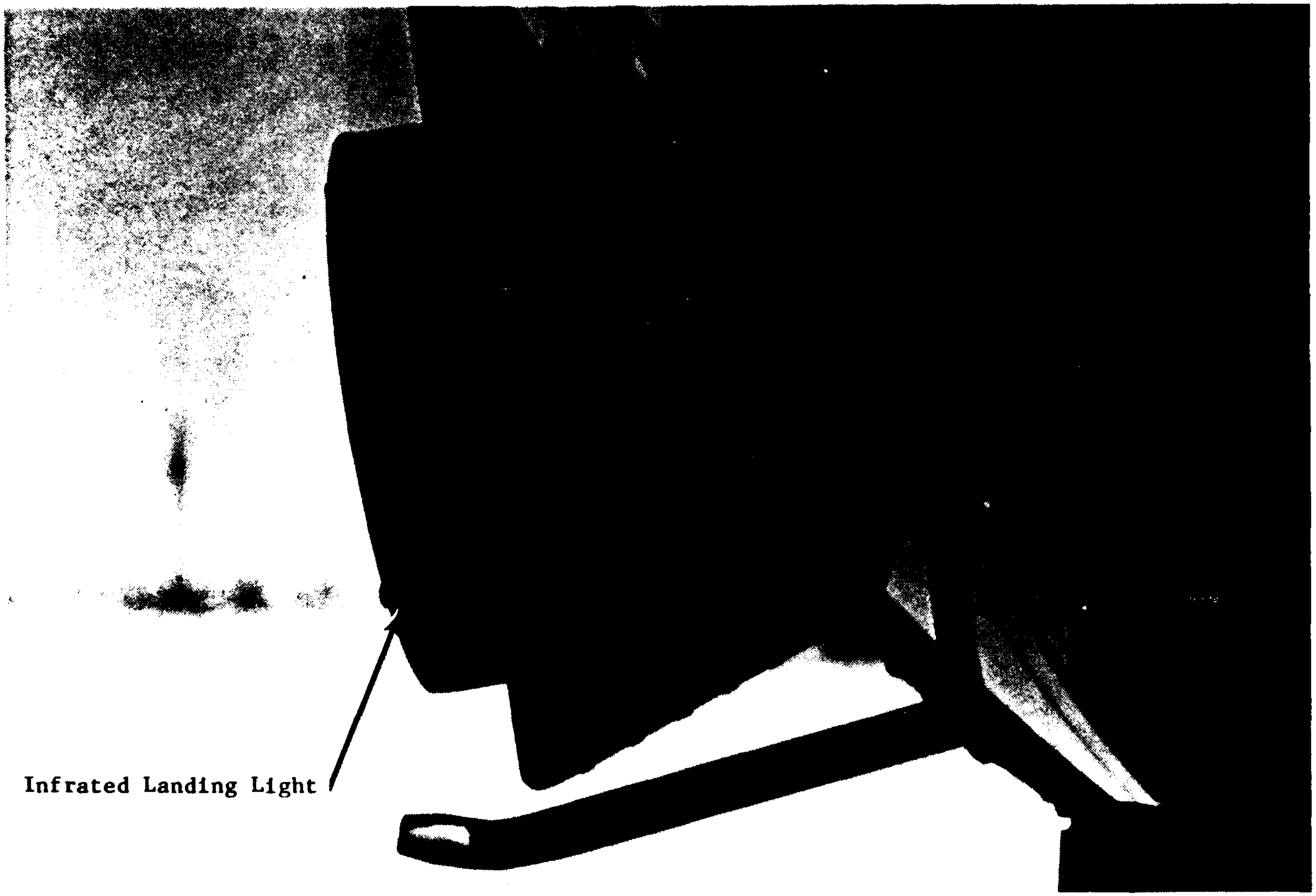


Photo 8. Standard Pitot Tube

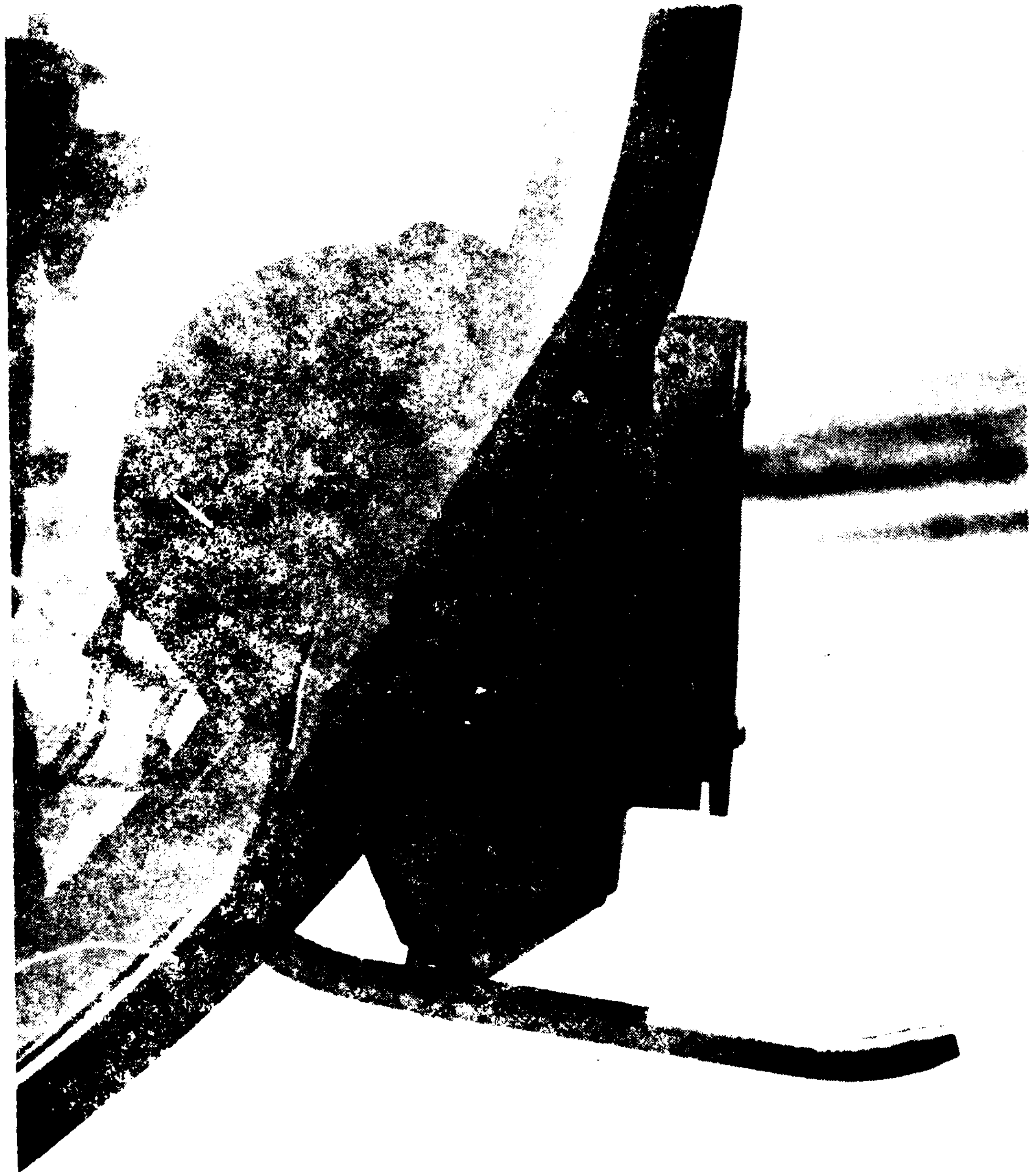


Photo 10. Radar Altimeter Antennas (Underside)

FIGURE 1
AIRWORTHINESS RELEASE GROSS WEIGHT - - LONGITUDINAL
CENTER-OF-GRAVITY ENVELOPE
JOH-6A LCH (AH-6C)

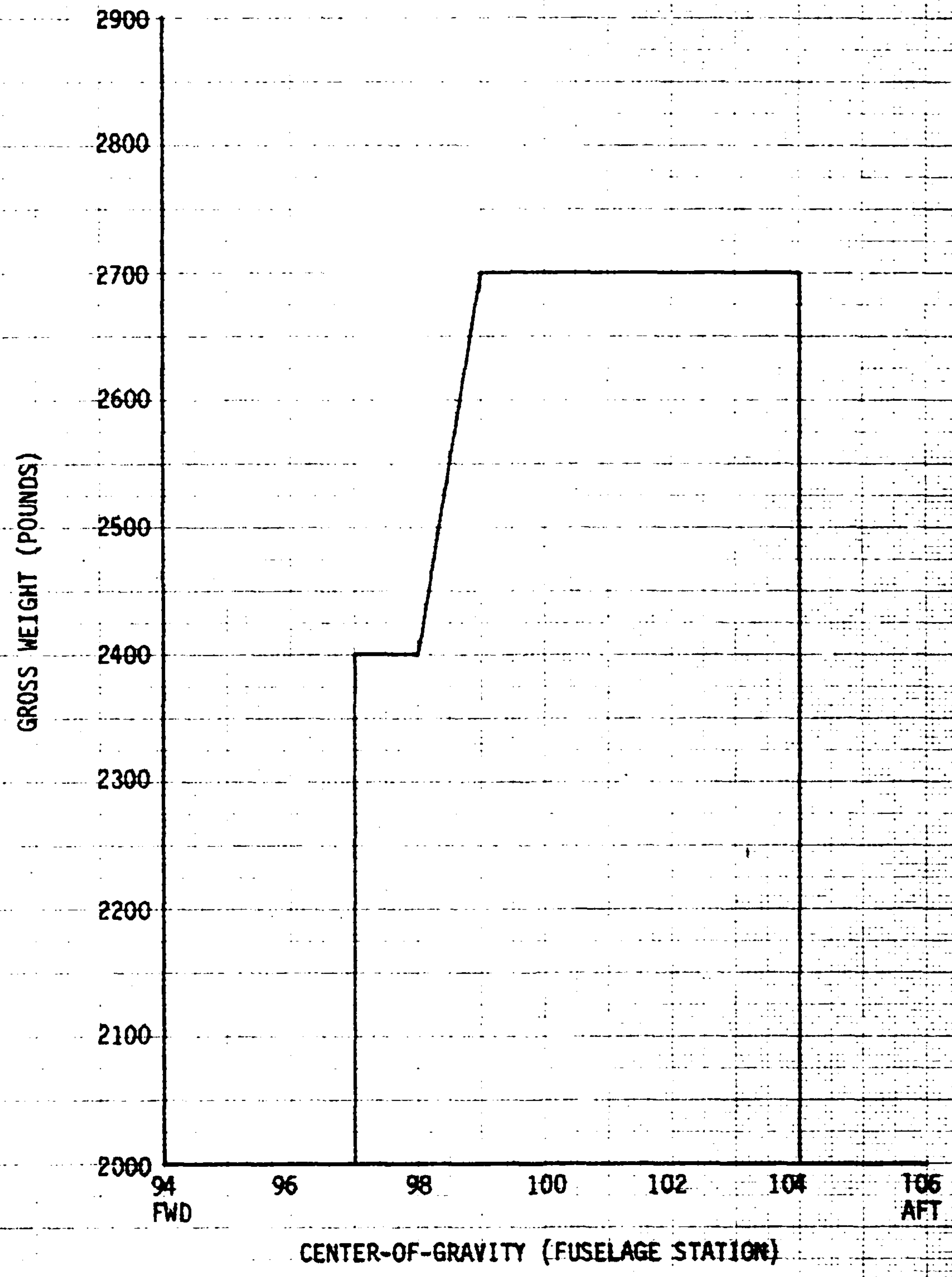
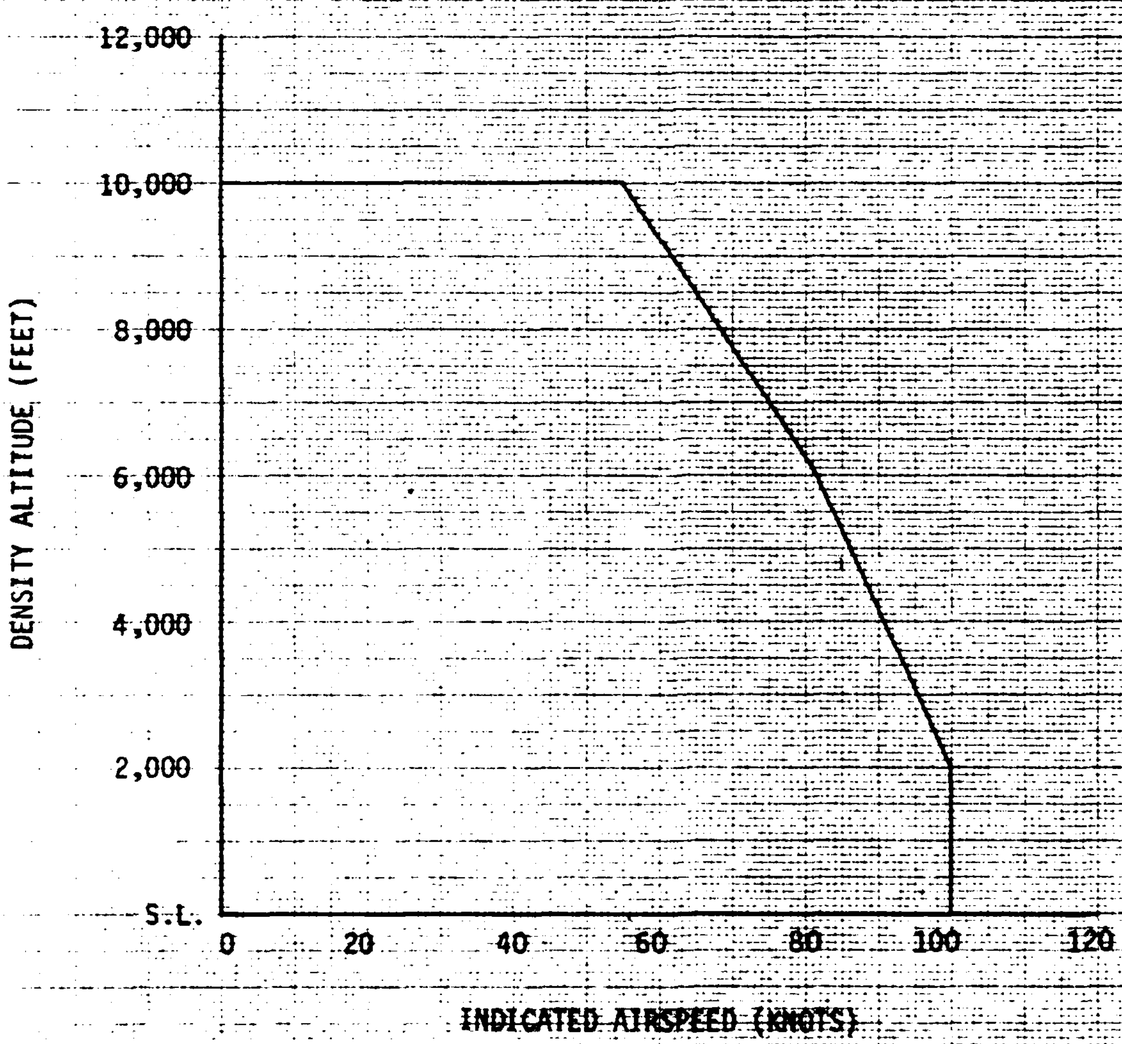


FIGURE 2
AIRWORTHINESS RELEASE AIRSPEED LIMITS
JOH-6A LCH (AH-6C)



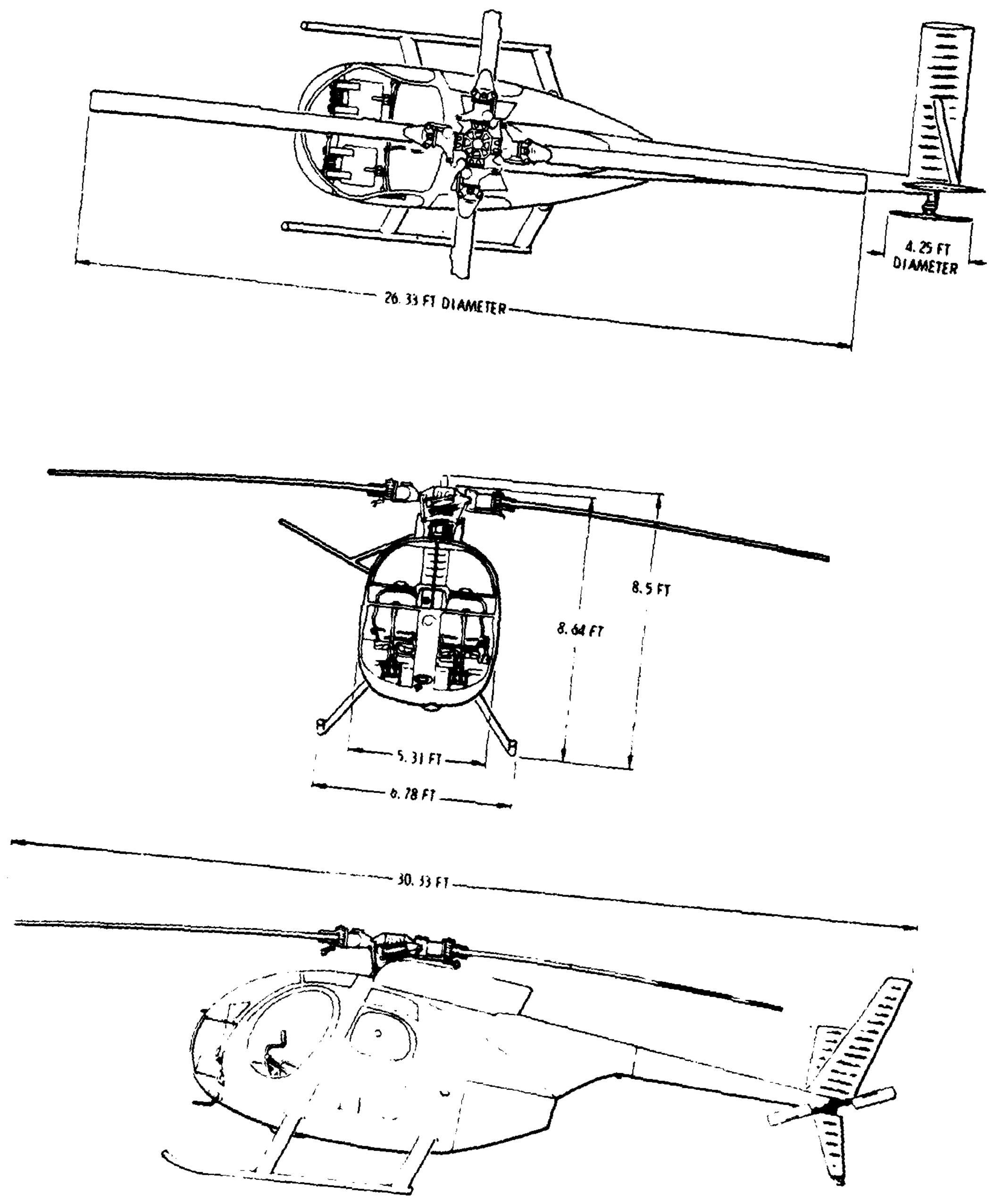


Figure 3. OH-6A Principal Dimensions

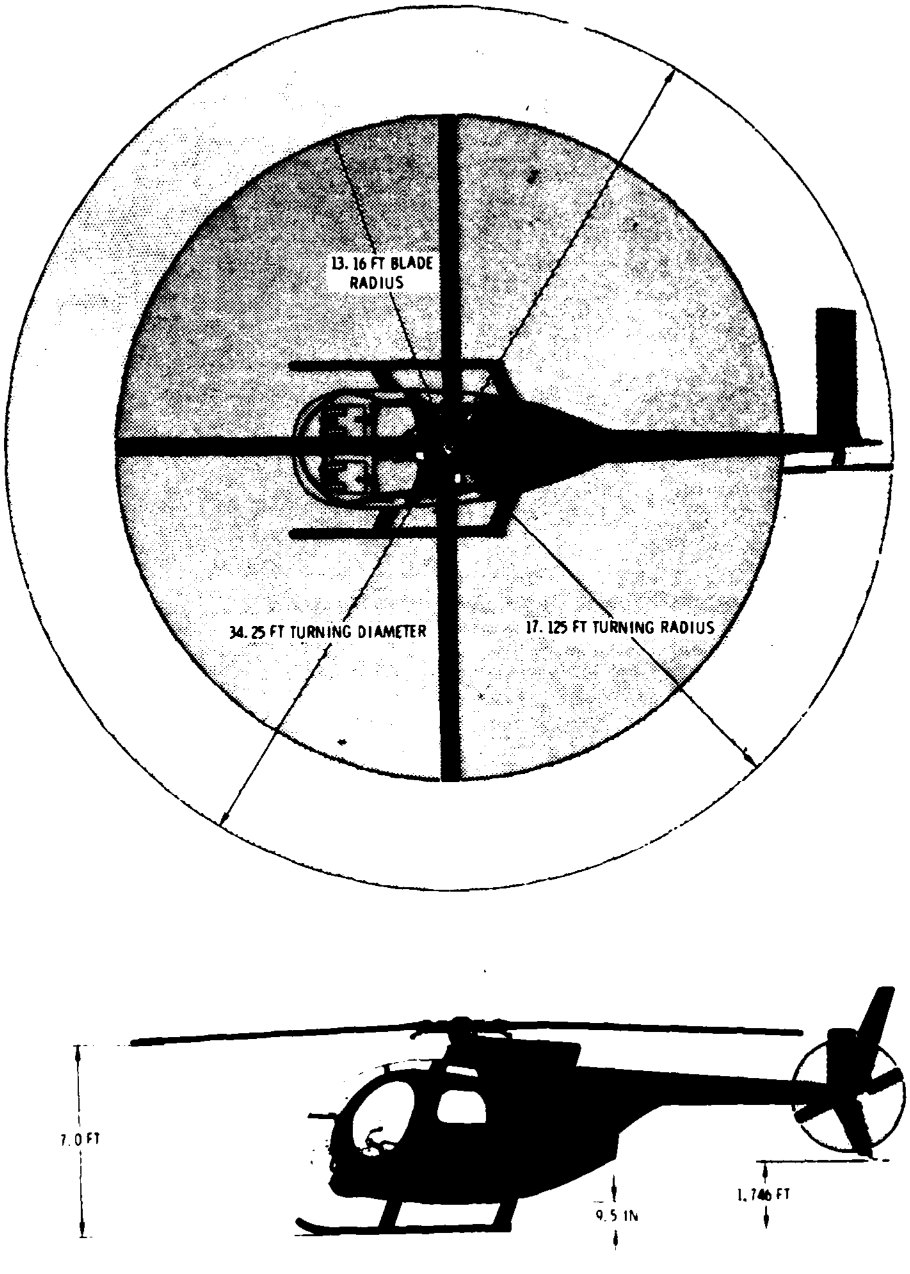


Figure 4. OH-6A Turning Radius and Ground Clearance

2) A second KY-28 secure control panel, an AN/ARC 164 VHF radio, AN/APR 39 radar warning display and control panel, AN/APN 209 radar altimeter display the AN/APX 100 transponder control panel and a sweep second hand clock were installed.

b. Lighting added:

1) External formation lights (photo 6)

2) External cateye position lights with shields (photo 6)

3) Infrared landing light in lieu of standard landing light (photo 8)

c. Installation of armament subsystems consisting of:

1) The 158A1 subsystem, a 275 inch folding fin aerial rocket pod with 7 launch tubes mounted on right side of the aircraft (photo 4).

2) The M27E1 subsystem with M134 machine gun, a six barrel 7.62 mm gun, on the left side of the aircraft (photo 5).

d. Rear seats and all doors were removed from the aircraft.

e. T63-A-720 engine installed (para 3) in lieu of the T63-A-5A.

f. Cambered tail rotor blade assembly Hughes P/N 369A 1620-21 with bungee tension spring force compensator, KT 309H9005-11 was installed.

g. Engine infrared (IR) exhaust suppressors Huges P/N 369P294900 were installed with rear exhaust port filled by tapered cone (photo 6).

h. A modified main transmission Hughes P/N 369A5100-615 was installed.

i. Omega navigation set was not installed, however, the omega antenna was installed on the aft underside of the tail boom (photo 7).

j. Dual whip FM antennas were installed at station 199 (photo 7).

k. Self adhesive stainless steel strips were added to the outboard 24" leading edge of all four main rotor blades.

l. The standard pitot tube was extended 4 inches (photos 8 and 9) forward in accordance with New Cumberland Army Depot Drawing No. 1560-04-6E-01B.

m. Radar altimeter antennas were mounted on an external tray located on the belly of the aircraft (photo 10).

APPENDIX C. INSTRUMENTATION

1. The test instrumentation system was designed, calibrated, installed, and maintained by USAAEFA. Digital and analog data were obtained from calibrated instrumentation and were recorded on magnetic tape and/or displayed in the cockpit. The instrumentation system consisted of various transducers, signal conditioning units, a ten-bit PCM encoder, and an Ampex AR 700 tape recorder. Time correlation was accomplished with a pilot/engineer event switch and onboard recorded and displayed Inter-Range Instrumentation Group (IRIG) B format time of day. Various specialized test indicators displayed data to the pilot and engineer continuously during the flight. A boom with the following sensors was mounted on the right skid tube of the aircraft: swiveling pitot-static head, sideslip vane, and angle-of-attack vane. Photos 1 through 3 show the instrumentation installation. The boom airspeed system calibration is shown in figures 1 through 3. The engine torquemeter calibration is shown in figure 4. Referred power versus fuel flow for the engine calibration is shown in figure 5.

2. The following parameters were displayed on calibrated instruments in the cockpit:

Airspeed (boom)
Airspeed (ship's system)
Altitude (boom)
Rotor speed
Engine torque
Fuel flow rate
Fuel used (totalizer)
Outside air temperature
Normal acceleration
Angle-of-sideslip
Vertical velocity
Time of day
Record counter

3. The following parameters were recorded on magnetic tape:

Time code
Run number
Pilot/engineer event
Fuel used
Airspeed (boom)
Altitude (boom)
Main rotor speed
Outside air temperature
Angle-of-sideslip
Angle-of-attack

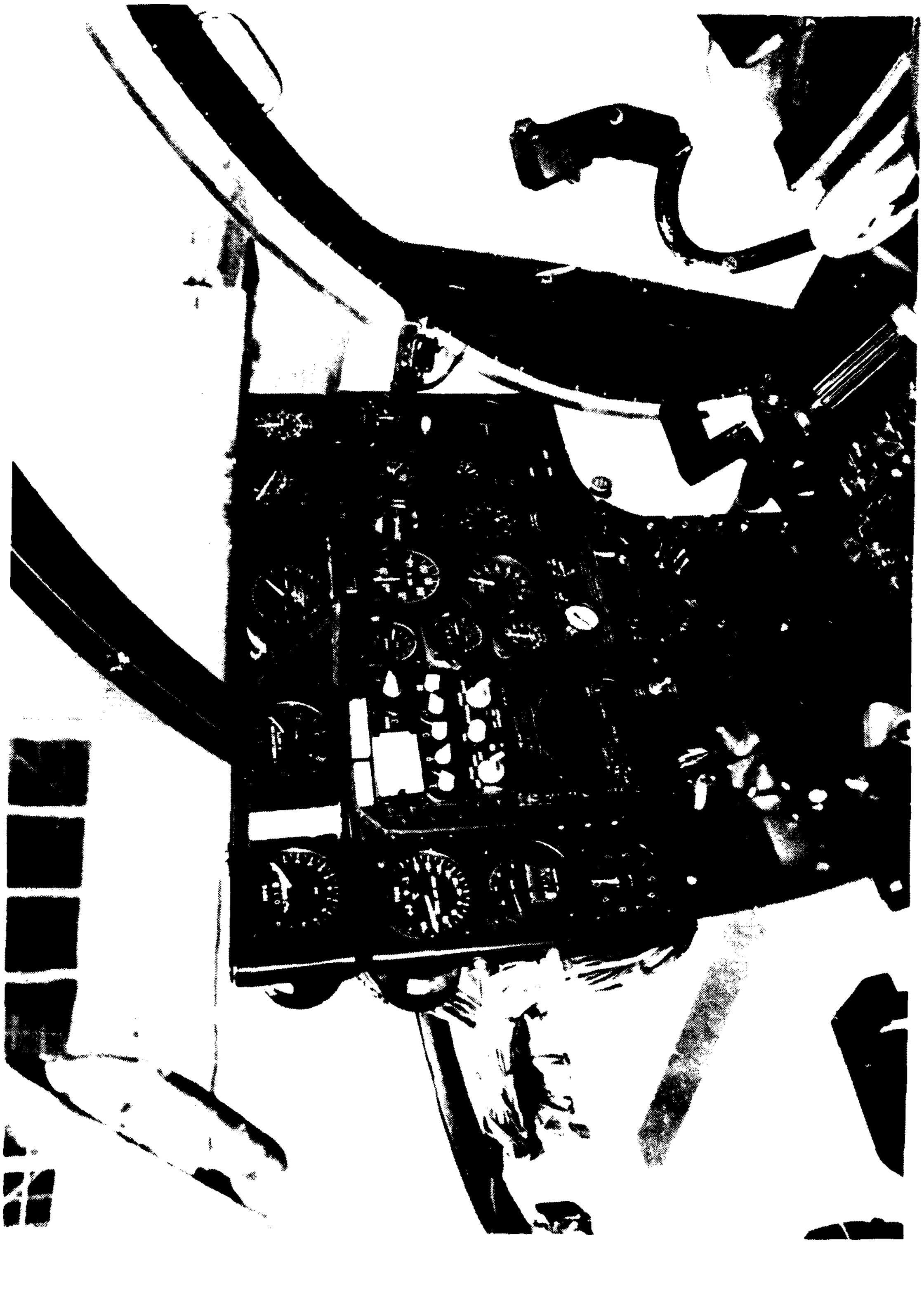


Photo 1. Cockpit Instrumentation

Photo 2. Instrumentation Package (Right Side)

Photo 3. Airspeed Boom (Attached to Right Skid)

FIGURE 1
BOOM AIRSPEED CALIBRATION
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
2500	98.8(FWD)	0.5 RT	7380	25.0	483	LEVEL

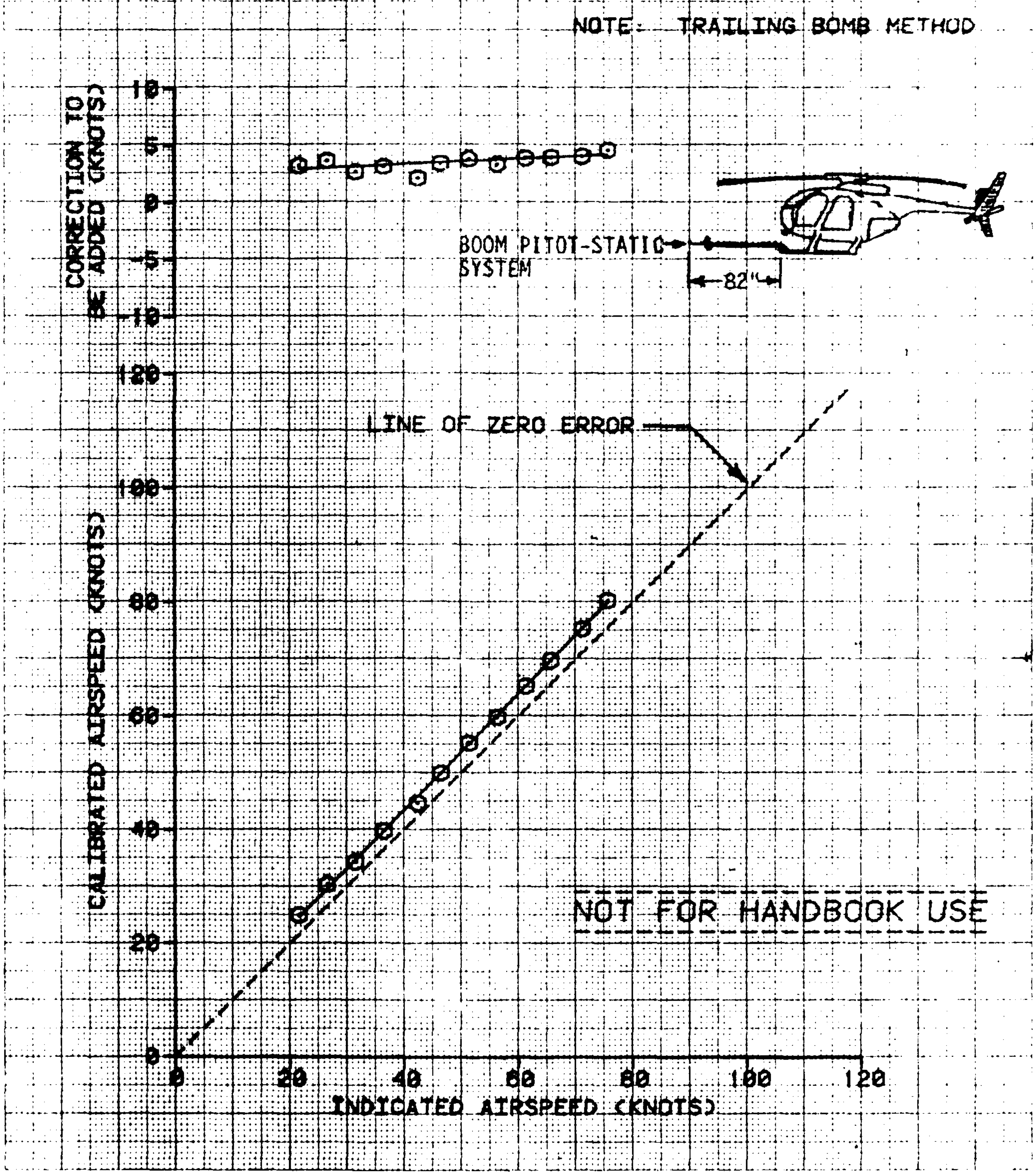


FIGURE 2
BOOM AIRSPEED CALIBRATION
JOH-6A LOH (AH-6C) USA S/N 69-16054

SYM	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION CLIMB
⊙	2460	98.8 (FWD)	0.5 R	7720	24.5	483	500 FT/MIN
⊡	2540	98.8 (FWD)	0.5 R	[illegible]	23.5	483	1000 FT/MIN

NOTE: TRAILING BOMB METHOD

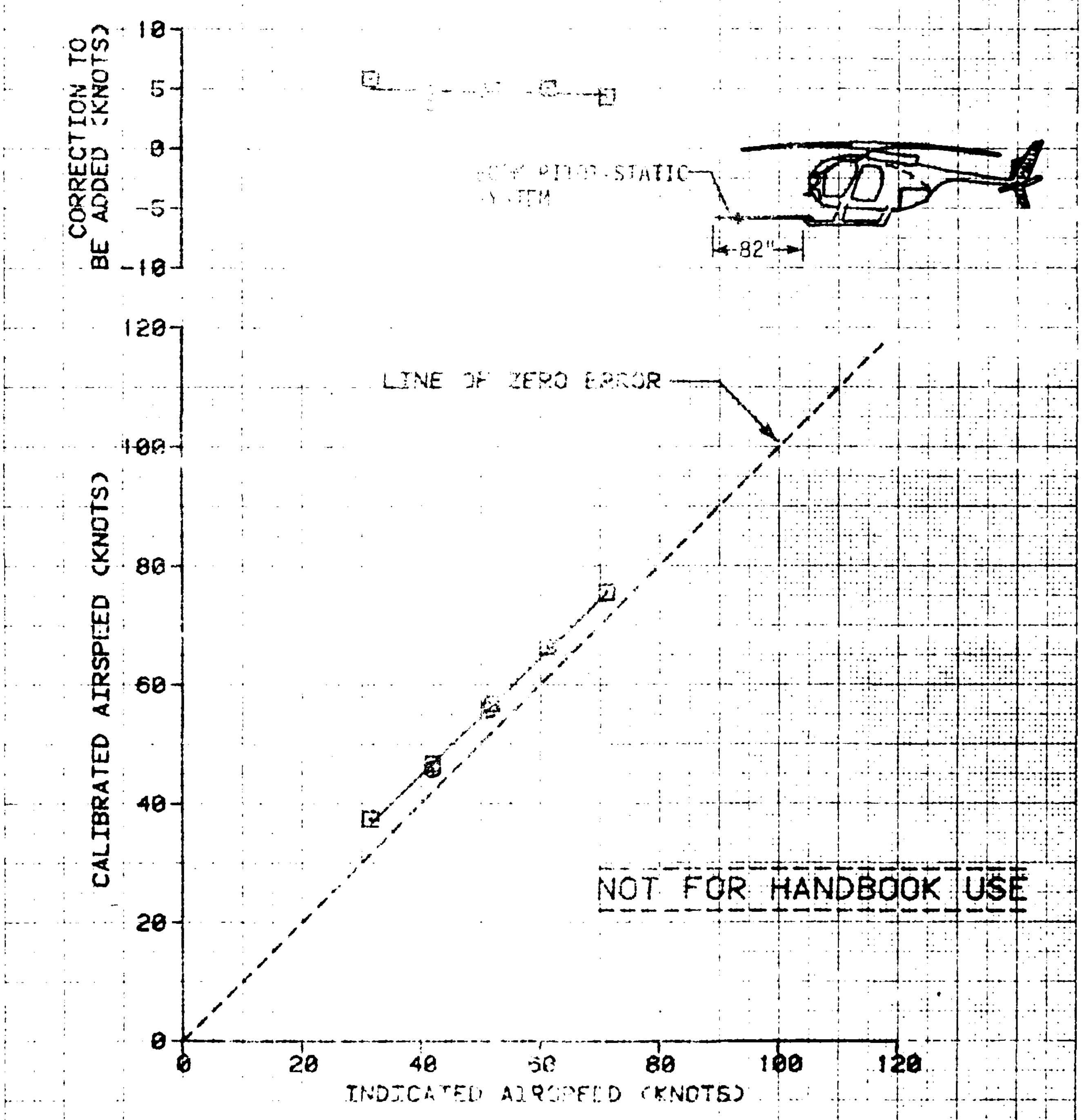


FIGURE 3

BOOM AIRSPEED CALIBRATION

JOH-6A LCH (AH-6C) USA S/N 69-16054

SYM	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
⊙	2460	98.8 (FWD)	0.5 [illegible]	7320	24.5	483	DESCENT 500 FT/MIN
⊡	2520	98.8 (FWD)	0.5 [illegible]	7620	23.5	483	1000 FT/MIN
△	2500	98.8 (FWD)	0.5 [illegible]	7540	24.5	482	AUTOROTATION

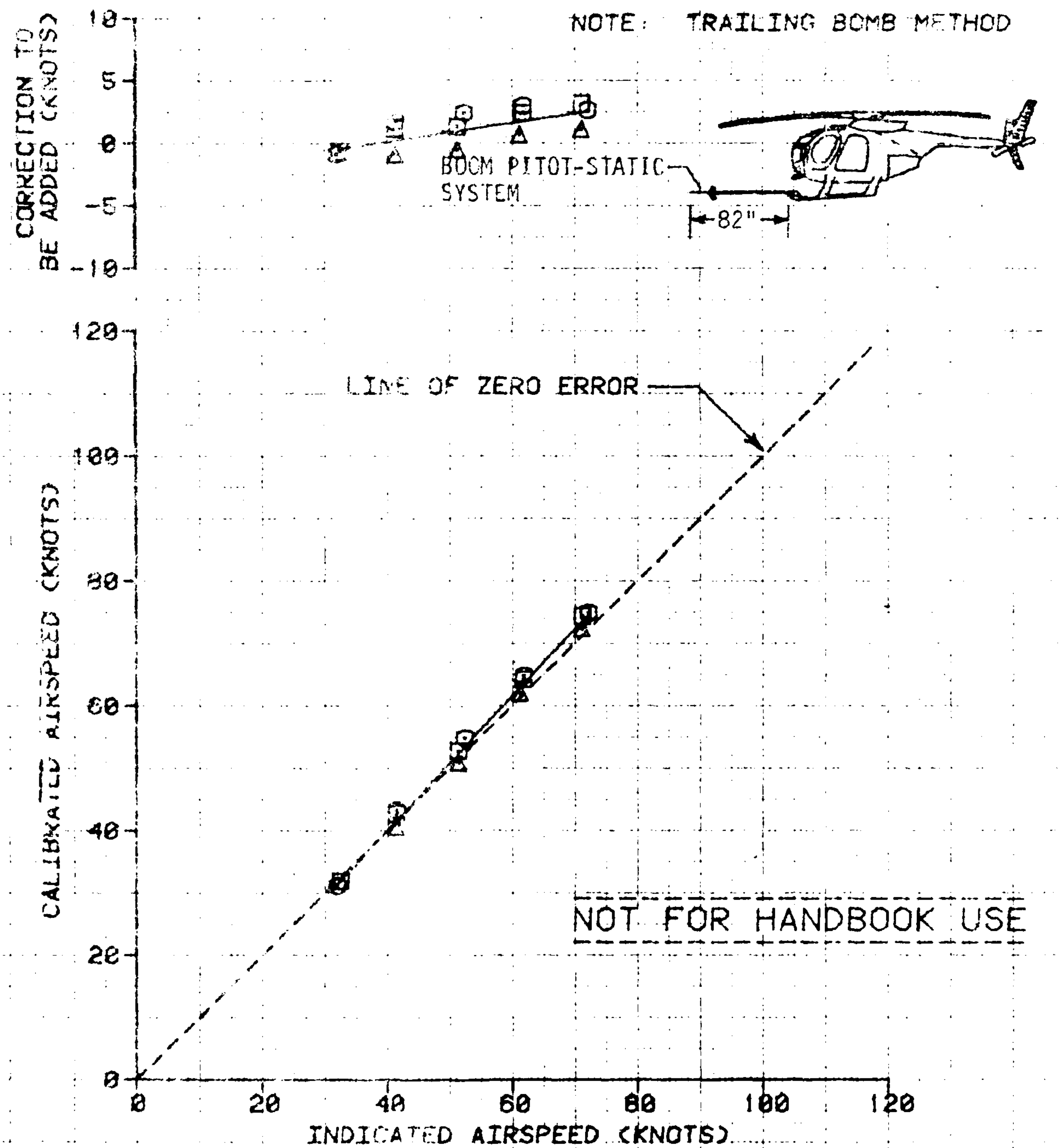


FIGURE 4

ENGINE TORQUEMETER CALIBRATION
ALLISON ENGINE MODEL T63-A-720 S/N 404430
TYPE FUEL - JET A
FUEL LOWER HEATING VALUE = 18510 BTU/LB
AVG COMPRESSOR INLET TEMPERATURE = 64 DEG F
POWER TURBINE SPEED = 34200 RPM

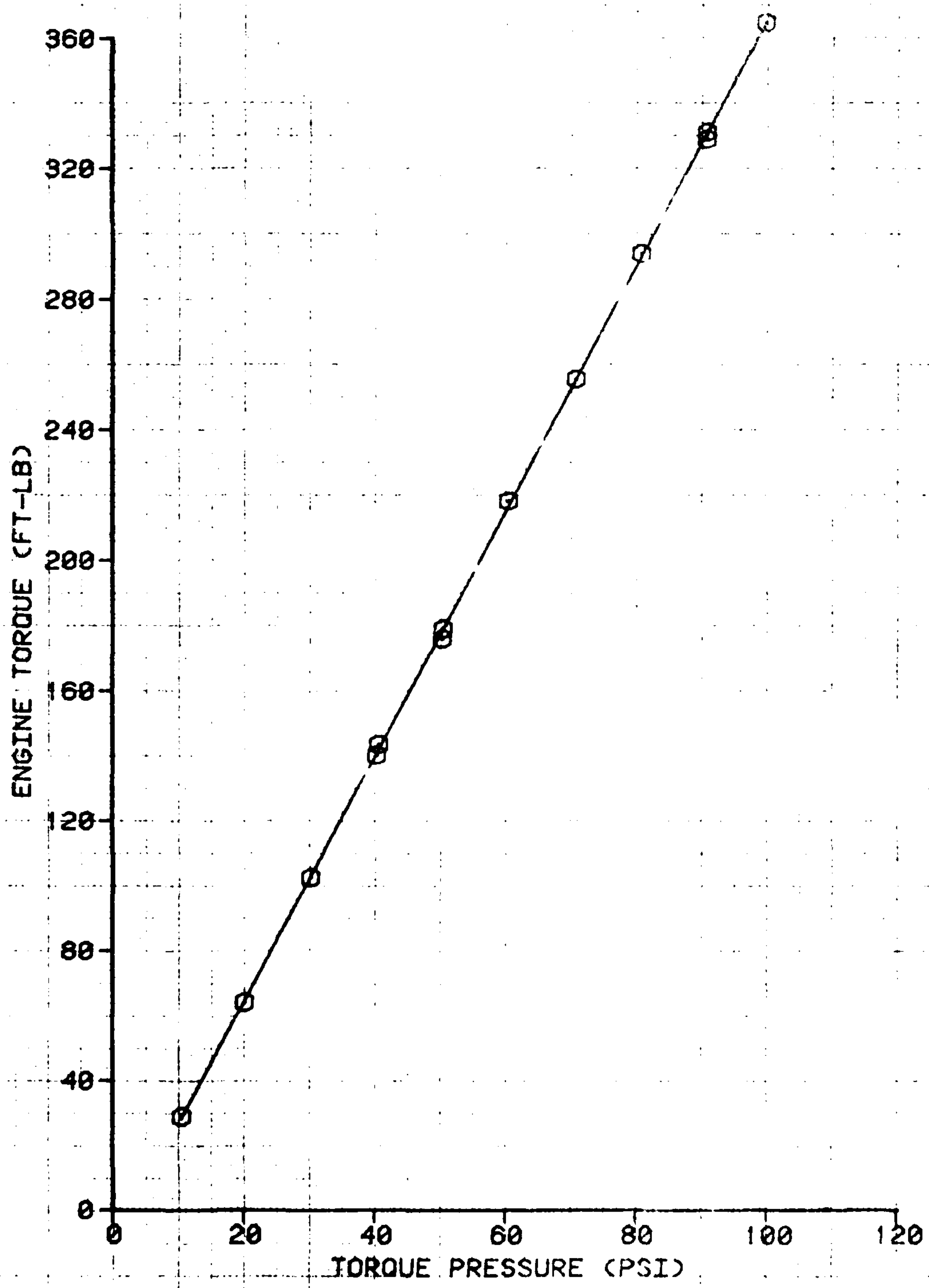
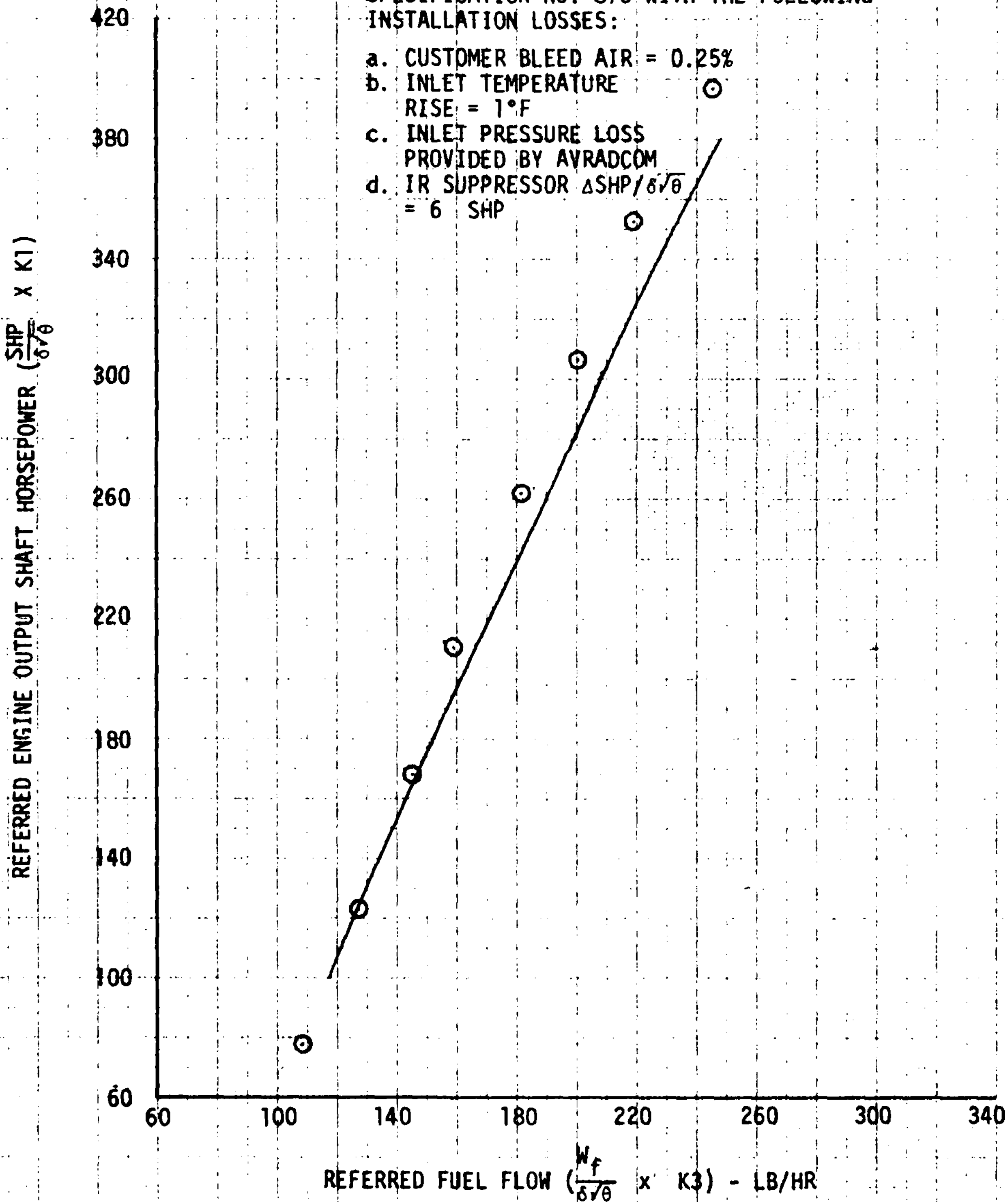


FIGURE 5
REFERRED POWER AND FUEL FLOW
ALLISON ENGINE MODEL T63-A-720 USA S/N 404430

NOTES:
1. POINTS OBTAINED DURING ENGINE CALIBRATION
2. CORRECTION FACTORS FOR SHAFT HORSEPOWER (K1) AND FUEL FLOW (K3) FROM ALLISON MODEL SPECIFICATION NO. 876
3. SPECIFICATION CURVE DERIVED FROM ALLISON MODEL SPECIFICATION NO. 876 WITH THE FOLLOWING INSTALLATION LOSSES:
   a. CUSTOMER BLEED AIR = 0.25%
   b. INLET TEMPERATURE RISE = 1°F
   c. INLET PRESSURE LOSS PROVIDED BY AVRADCOM
   d. IR SUPPRESSOR $\Delta SHP/\delta\sqrt{\theta}$ = 6 SHP



Engine torque
Turbine outlet temperature
Gas producer speed
Power turbine output shaft speed
Fuel flow rate
Control positions
- Longitudinal
- Lateral
- Directional
- Collective

Aircraft attitudes and rates
- Pitch
- Roll
- Yaw

Aircraft center of gravity accelerations
- Longitudinal
- Lateral
- Normal

Pilot seat accelerations
- Longitudinal
- Lateral
- Vertical

APPENDIX D. TEST TECHNIQUES AND DATA ANALYSIS METHODS

PERFORMANCE

1. The helicopter performance test data were generalized by use of nondimensional coefficients and were such that the effects of compressibility and blade stall were not separated and defined. The following nondimensional coefficients were used to generalize the hover and level flight test results obtained during this flight test program.

a. Coefficient of Power (C_P):

$$C_P = \frac{SHP\ (550)}{\rho A(\Omega R)^3} \qquad (1)$$

b. Coefficient of Thrust (C_T):

$$C_T = \frac{Thrust}{\rho A(\Omega R)^2} \qquad (2)$$

c. Advance Ratio (μ):

$$\mu = \frac{V_T\ (1.6878)}{\Omega R} \qquad (3)$$

d. Advancing tip Mach number (M_{tip}):

$$M_{tip} = \frac{1.6878\ V_T + (\Omega R)}{a} \qquad (4)$$

Where:

SHP = Engine output shaft horsepower

550 = Conversion factor (ft-lb/sec/shp)

ρ = Air density (slug/ft^3)

A = Main rotor disc area (ft^2) = 544.91

Ω = Main rotor angular velocity (radian/sec = 50.58 at 483 rpm)

R = Main rotor radius (ft) = 13.17

Thrust = Gross weight (lb) during free flight in which there is no acceleration component in the vertical direction.

1.6878 = Conversion factor (ft/sec/knot)

V_T = True airspeed (knot) = (calibrated airspeed)/$\sqrt{\sigma}$

σ = Density ratio = ρ/ρ_0 = δ/θ

ρ_0 = Air density at sea level standard day (slug/ft^3) = 0.0023769

$\delta = [1 - (6.875586 \times 10^{-6})H_P]^{5.255863}$

H_P = Pressure altitude (feet)

$\theta = (T + 273.15)/288.15$

a = Speed of sound (ft/sec) = $1116.45\sqrt{\theta}$

T = Ambient air temperature (°C)

For a rotor speed of 483 rpm the following constants were used:

A = 544.91

ΩR = 666.13

$A(\Omega R)^2$ = 241793415.4 ft^4/sec^2

$A(\Omega R)^3$ = $1.610667863 \times 10^{11}$ ft^5/sec^3

Shaft Horsepower Required

2. The engine output shaft torque was determined from the engine manufacturer's torque system. The relationship of measured torque pressure (psi) to engine output shaft torque (in-lb) as determined in the engine test cell calibration is shown in figure 4, appendix C. The output shp was determined from the engine output shaft torque and rotational speed by the following equation:

$$SHP = \frac{2\pi \times N_P \times Q}{33{,}000} \qquad (5)$$

Where:

N_P = Engine output shaft rotational speed (rpm)

Q = Engine output shaft torque (ft-lb)

33,000 = Conversion factor (ft-lb/min/shp)

Hover

3. Hover performance was obtained at 2-foot and 50-foot skid heights by the free flight hover technique. All hover tests were conducted in winds of less than 3 knots. Atmospheric pressure, temperature, and wind velocity were recorded from a ground weather station. Free flight hover tests consisted of stabilizing the helicopter at a desired height with reference to a premeasured weighted cord hung from the front of the right landing gear skid. Ballast was incrementally removed from the aircraft until the minimum gross weight was obtained. All hover data were reduced to nondimensional parameters of C_P and C_T (equations 1 and 2, respectively), and grouped according to skid height.

Level Flight Performance and Specific Range

4. Level flight performance data were reduced using equations 1, 2, and 3. The speed power was flown at a predetermined constant C_T by maintaining a constant gross weight to density ratio (W/σ). The aircraft was flown in zero sideslip flight with altitude increased between data points to maintain the constant W/σ.

5. Test-day (measured) level flight power was corrected to standard-day conditions by assuming that the test-day nondimensional parameters C_{P_t}, C_{T_t}, and μ_t, are identical to C_{P_s}, C_{T_s}, and μ_s, respectively.

From equation 1, the following relationship can be derived:

$$SHP_s = SHP_t \left(\frac{\rho_s}{\rho_t}\right) \tag{6}$$

Where:

Subscript t = test day
Subscript s = standard day

6. Test specific range was calculated using level flight performance data and the measured fuel flow.

$$SR = \frac{V_T}{\overline{W_f}} \tag{7}$$

Where:

SR = Specific range (nautical air miles per pound of fuel)

V_T = True airspeed (knot)

W_f = Fuel flow (lb/hr)

Sawtooth Climbs and Autorotational Descents

7. A series of sawtooth climbs and autorotational descents were flown to determine generalized climb and descent performance. The rates of climb and descent (dH_P/dt) were determined from the rate of change of boom pressure altitude (H_P) with time, corrected for instrument error. Tapeline rate of climb as computed using the following equation:

$$R/C = 60 \left(\frac{dH_p}{dt}\right)\left(\frac{T_t}{T_s}\right) \tag{8}$$

Where:

$\frac{dH_p}{dt}$ = Slope of pressure altitude versus time curve at a given pressure altitude (ft/sec)

T_t = Test ambient air temperature at the pressure altitude at which the slope is taken (°K)

T_s = Standard ambient air temperature at the pressure altitude at which the slope is taken (°K)

8. Climb performance data were reduced to generalized parameters to provide a format for computing performance at any specified climb conditions. The following parameters were used to generalize the climb data:

Generalized power, variation from level flight:

$$C_{P_{GEN}} = \frac{C_{P_C} - C_{P_L}}{0.707\ C_T 1.5} \tag{9}$$

Vertical velocity ratio:

$$VVR = \frac{V_V}{\Omega R\sqrt{C_T/2}} \tag{10}$$

Forward velocity ratio:

$$FVR = \frac{V_F}{\Omega R\sqrt{C_T/2}} \tag{11}$$

Where:

C_{P_c} = Climb power coefficient

C_{P_L} = Level flight power coefficient

V_V = Vertical velocity (ft/sec) = Rate of climb/60

V_F = Forward velocity (ft/sec) = $\sqrt{(VT \times 1.6878)^2 - V_V{}^2}$

9. Climb power required for any condition can then be computed from these equations by determining $\Delta C_{P_{GEN}}$ as a function of the VVR and FVR required for the specific condition. The level flight power coefficient (C_{P_L}) was obtained from the nondimensional level flight performance curves.

$$C_{P_C} = 0.707\ C_{P_{GEN}} + C_{P_L} \tag{12}$$

10. The climb power correction coefficient (K_P) can be derived as a function of dimensional and nondimensional terms as shown below:

Dimensional:

$$K_P = \left(\frac{\Delta R/C}{\Delta SHP}\right)\left(\frac{GW}{33000}\right) \tag{13}$$

Nondimensional:

$$K_P = \left(\frac{\Delta\mu_v}{\Delta C_P}\right) \left(C_T\right) \tag{14}$$

HANDLING QUALITIES

11. Stability and control data were collected and evaluated using standard test methods as described in reference 5, appendix A. Definitions of deficiencies and shortcomings used during this test are shown below.

a. Deficiency. A defect or malfunction discovered during the life cycle of an item of equipment that constitutes a safety hazard to personnel; will result in serious damage to the equipment if operation is continued; or indicates improper design or other cause of failure of an item or part, which seriously impairs the equipment's operational capability.

b. Shortcoming. An imperfection or malfunction occurring during the life cycle of equipment which must be reported and which should be corrected to increase efficiency and to render the equipment completely serviceable. It will not cause an immediate breakdown, jeopardize safe operation, or materially reduce the usability of the material or end product.

AIRSPEED CALIBRATION

12. The boom and ships pitot-static system was calibrated by using the trailing bomb method to determine the airspeed position error. Calibrated airspeed (V_{cal}) was obtained by correcting indicated airspeed (V_i) using instrument (ΔV_{ic}) and position (ΔV_{pc}) error corrections.

$$V_{cal} = V_i + \Delta V_{ic} + \Delta V_{pc} \tag{15}$$

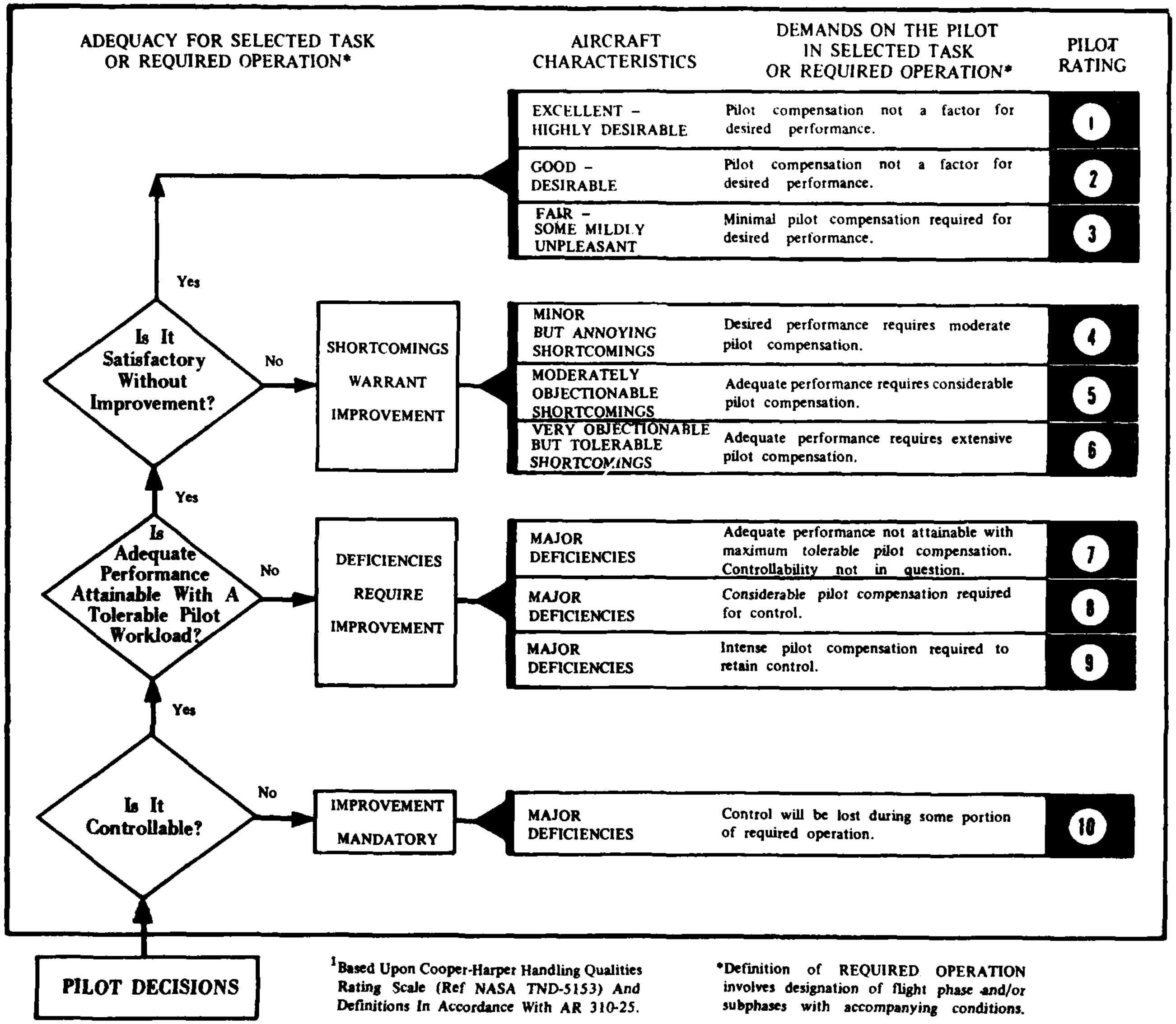
Weight and Balance

13. Prior to testing, the aircraft gross weight and cg location were determined by using calibrated scales. The aircraft was weighed with full instrumentation on board, without fuel, and was in the LCH configuration except for the rocket pod and mount. The aircraft could not be weighed with the rocket pod and mount installed since the rocket pod mount utilizes the aircraft jacking

point. The aircraft weight was calculated to be 1872 pounds after addition of the rocket pod and mount weights, with a longitudinal cg location at fuselage station 104.60 and a lateral cg location at butt line 0.50 right.

HANDLING QUALITIES RATING SCALE

14. The Handling Qualities Rating Scale (HQRS) presented in figure 1 was used to augment pilot comments relative to handling qualities and workload.



[1] Based Upon Cooper-Harper Handling Qualities Rating Scale (Ref NASA TND-5153) And Definitions In Accordance With AR 310-25.

*Definition of REQUIRED OPERATION involves designation of flight phase and/or subphases with accompanying conditions.

Figure 1. Handling Qualities Rating Scale

APPENDIX E. TEST DATA

INDEX

FIGURE 1
HOVER PERFORMANCE SUMMARY
JOH-6A LCH (AH-6C) USA S/N 69-16054

IN GROUND EFFECT
TAKEOFF RATED POWER

NOTES:
1. MAIN ROTOR SPEED = 483 RPM
2. SKID HEIGHT = 2 FEET
3. SHP BASED ON ALLISON 250-C20B ENGINE MODEL SPECIFICATION 876 DATED 12 SEPTEMBER 1975
4. LCH CONFIGURATION

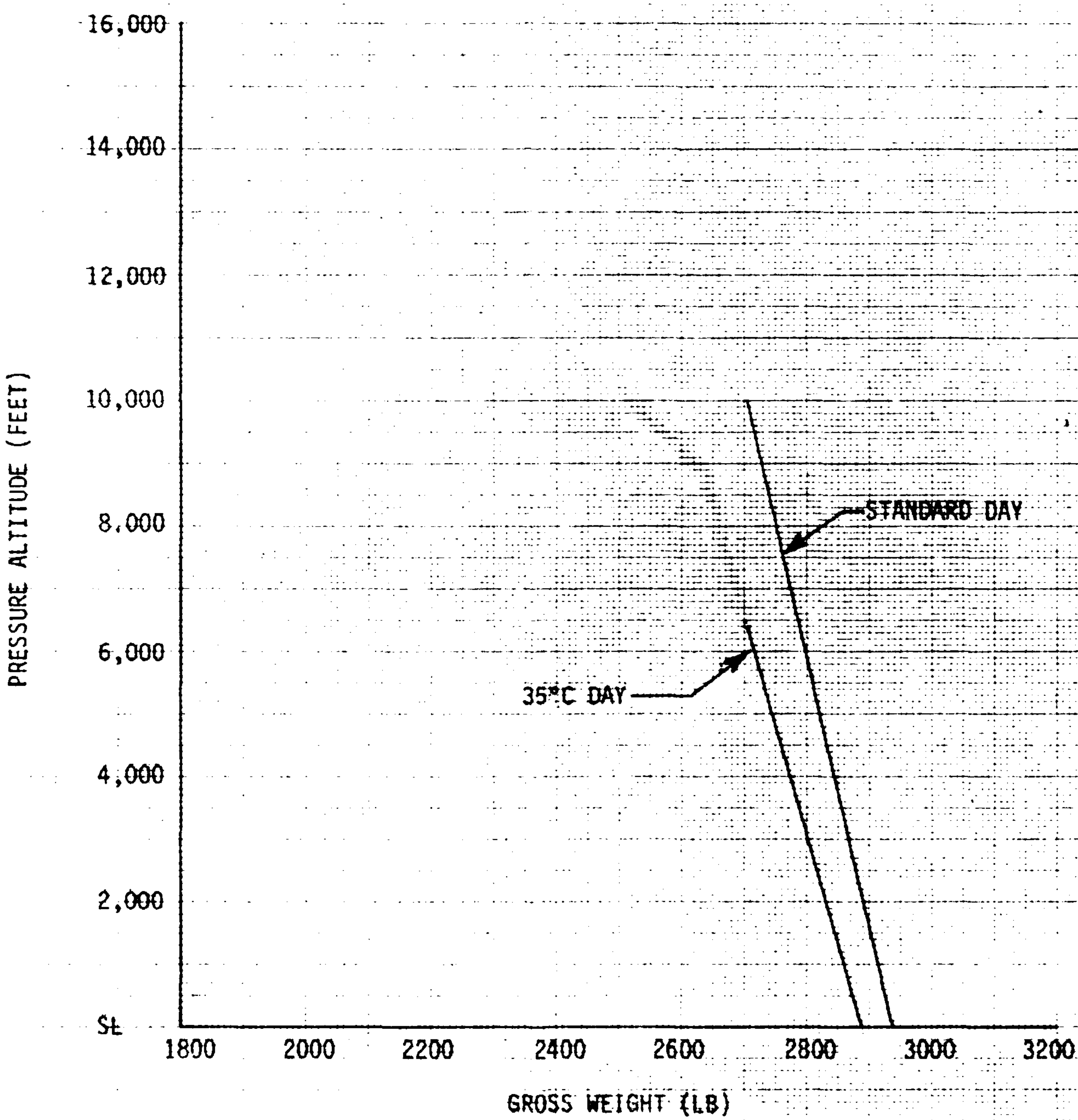


FIGURE 2
HOVER PERFORMANCE SUMMARY
JOH-6A LCH (AH-6C) USA S/N 69-16054

OUT OF GROUND EFFECT
TAKEOFF RATED POWER

NOTES:
1. MAIN ROTOR SPEED = 483 RPM
2. SKID HEIGHT = 50 FEET
3. SHP BASED ON ALLISON 250-C20B ENGINE MODEL SPECIFICATION 876 DATED 12 SEPTEMBER 1975
4. LCH CONFIGURATION

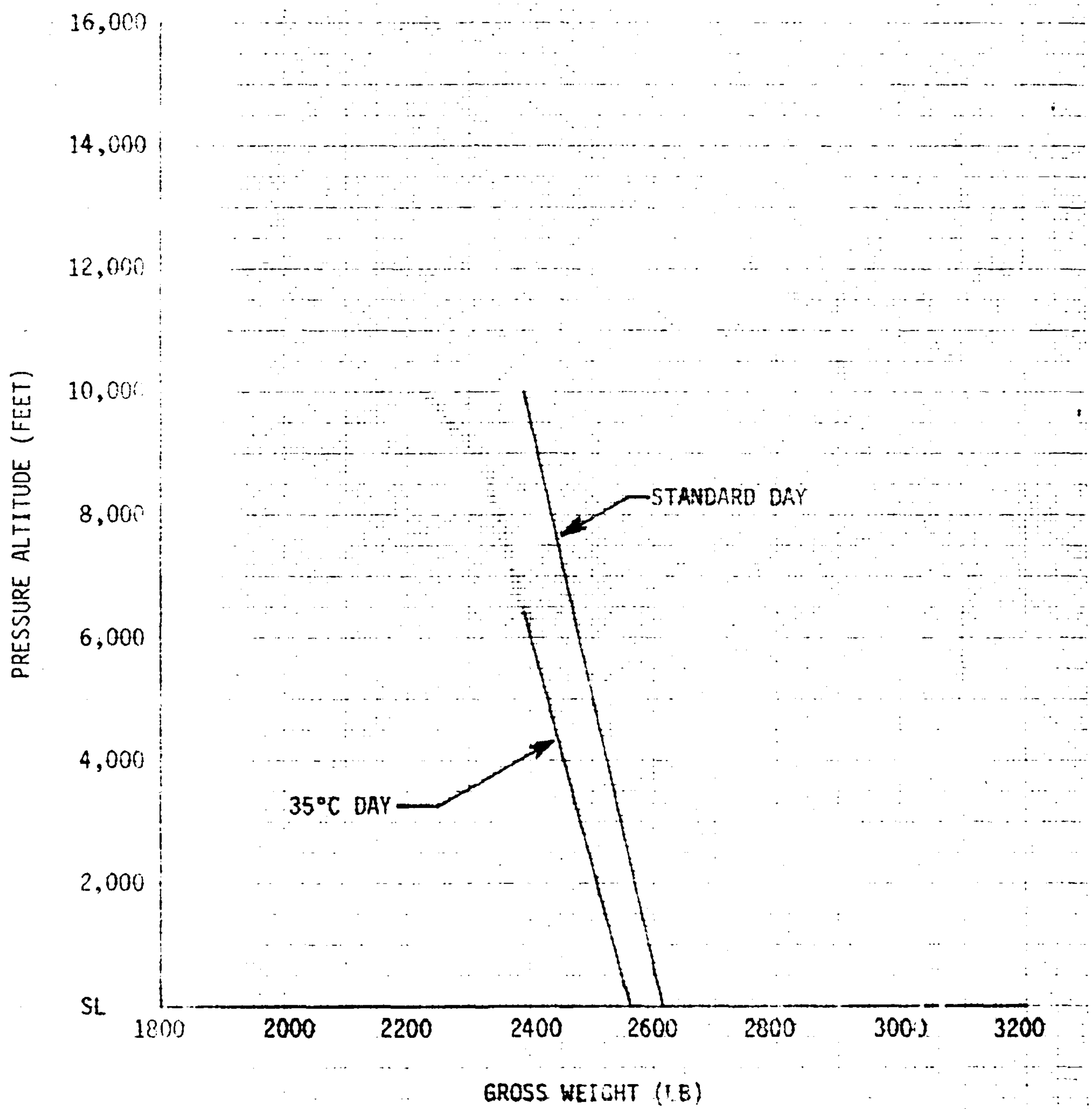
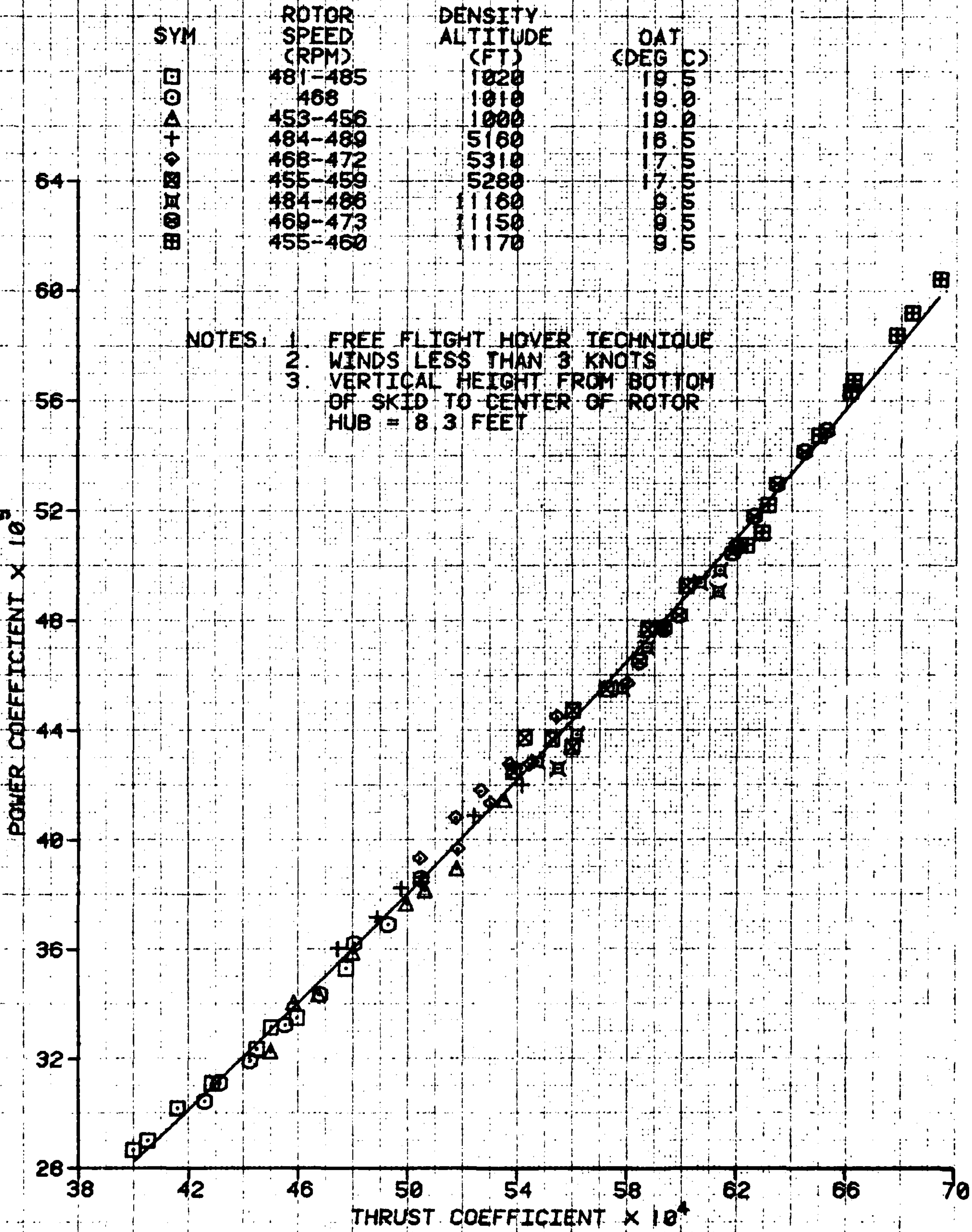


FIGURE 3
NONDIMENSIONAL HOVERING PERFORMANCE
JOH-6A LCH (AH-6C) USA S/N 69-16054
SKID HEIGHT = 2 FEET



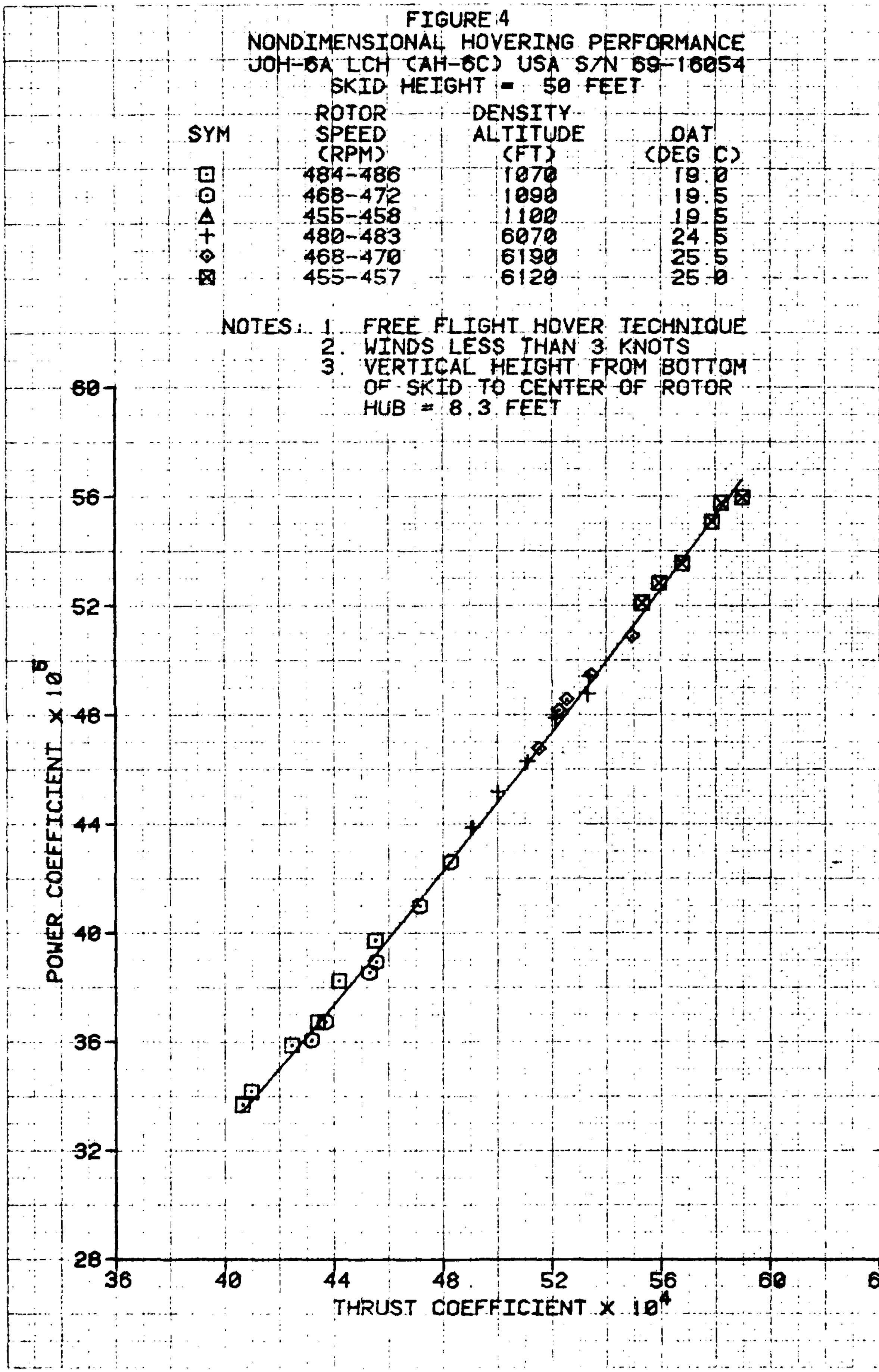


FIGURE 4
NONDIMENSIONAL HOVERING PERFORMANCE
JOH-6A LCH (AH-6C) USA S/N 69-16054
SKID HEIGHT = 50 FEET
SYM
ROTOR SPEED (RPM)
DENSITY ALTITUDE (FT)
OAT (DEG C)
484-486 1070 19.0
468-472 1090 19.5
455-458 1100 19.5
480-483 6070 24.5
468-470 6190 25.5
455-457 6120 25.0
NOTES: 1. FREE FLIGHT HOVER TECHNIQUE
2. WINDS LESS THAN 3 KNOTS
3. VERTICAL HEIGHT FROM BOTTOM OF SKID TO CENTER OF ROTOR HUB = 8.3 FEET
POWER COEFFICIENT X 10^5
THRUST COEFFICIENT X 10^4
28
32
36
40
44
48
52
56
60
36
40
44
48
52
56
60
64

FIGURE 5

FORWARD FLIGHT CLIMB PERFORMANCE SUMMARY

JOH-6A LCH (AH-6C) USA S/N 69-16054

NOTES: 1. LCH CONFIGURATION
2. ROTOR SPEED = 483 RPM
3. GROSS WEIGHT = 2700 LB
4. CLIMB SPEED BASED ON FIGURE 6
5. DATA DERIVED FROM FIGURES 6 & 7
6. TAKEOFF RATED POWER

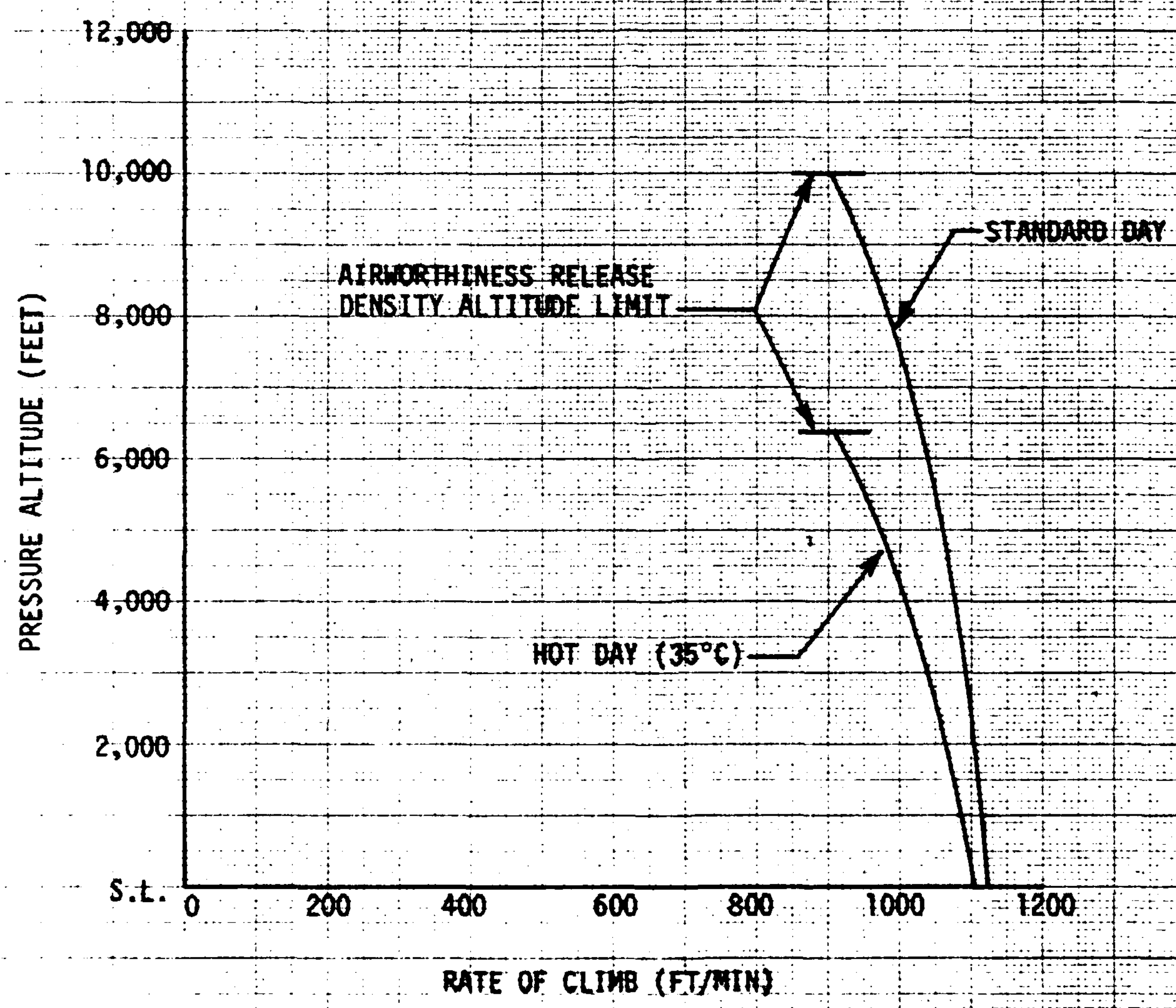


FIGURE 6
FORWARD FLIGHT CLIMB AIRSPEED SCHEDULE
JOH-6A LCH (AH-6C) USA S/N 69-16054

GROSS WEIGHT - 2700 LB
ROTOR SPEED - 483 RPM

NOTE: DATA DERIVED FROM FIGURES 8 AND 9

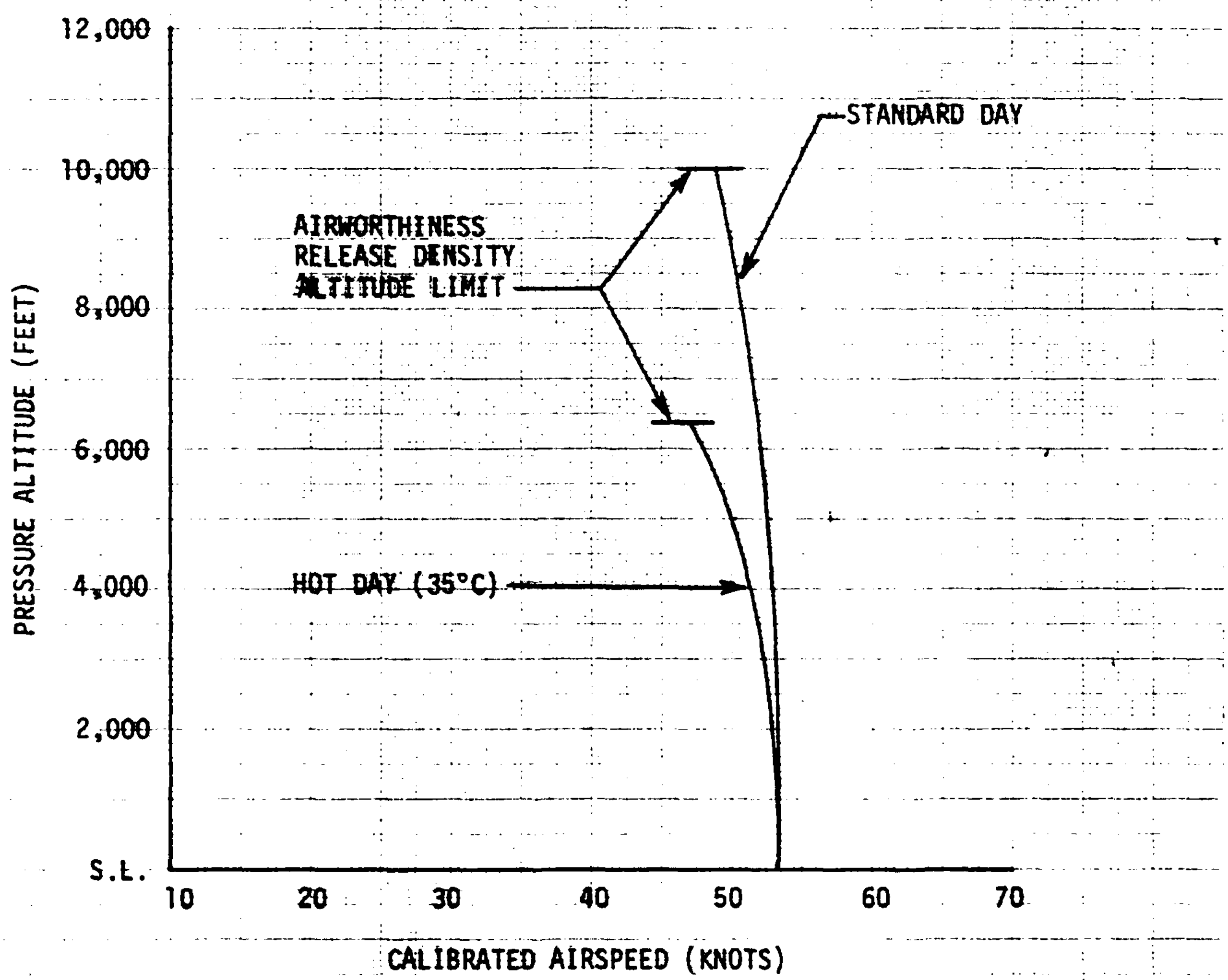


FIGURE 7
GENERALIZED CLIMB PERFORAMNCE
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	AVG C_T	FORWARD VELOCITY RATIO
2520	98.6(FWD)	0.5 RT	22.0	485	0.00553	2.97

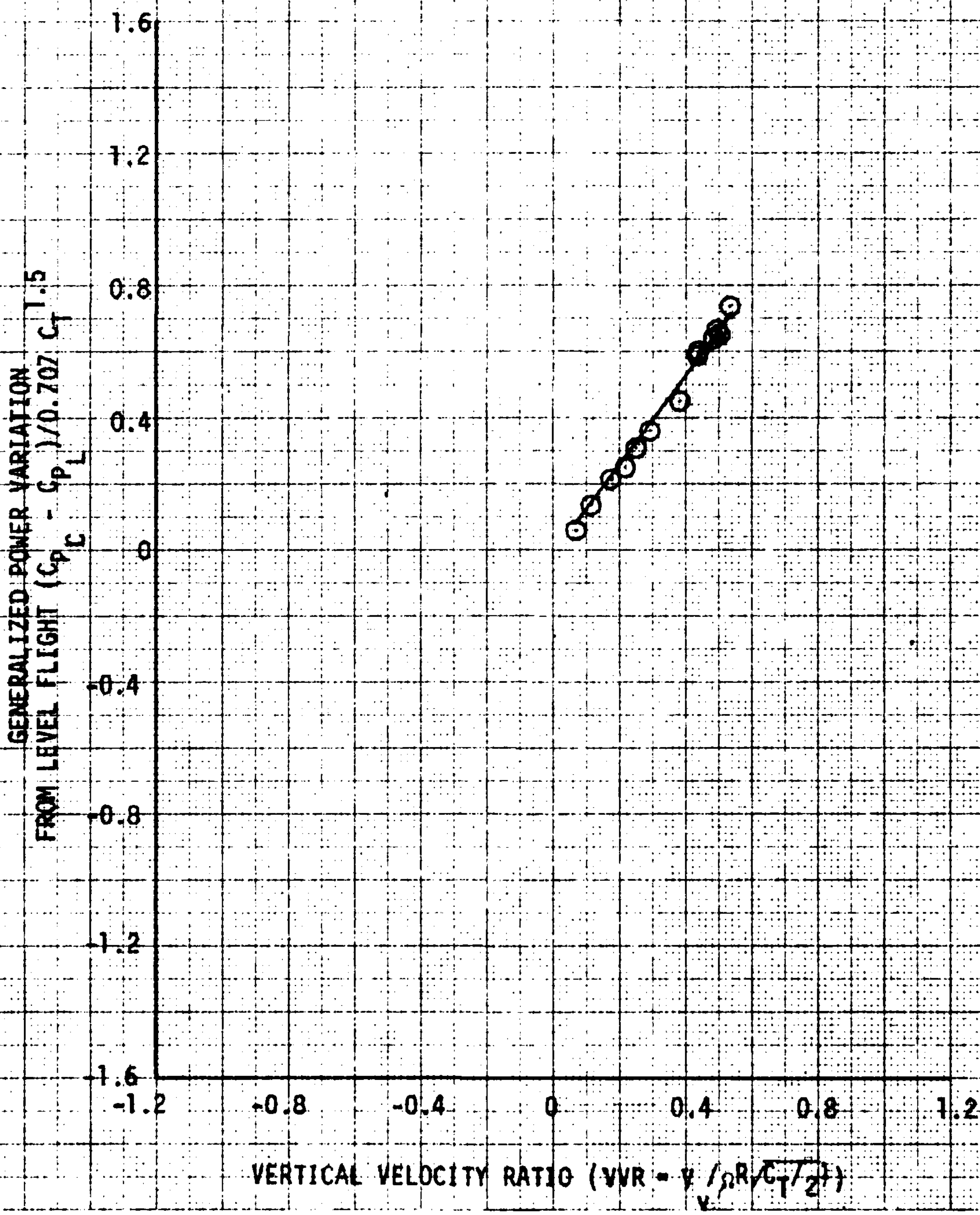


FIGURE 8
NONDIMENSIONAL LEVEL FLIGHT PERFORMANCE
JOH-6A LCH (AH-6C) USA S/N 69-16054

NOTES: 1. ZERO SIDESLIP
2. AVG LONGITUDINAL CG = FS 99.1 (FWD)
3. CURVES DRIVED FROM FIGURES 10 THROUGH 14

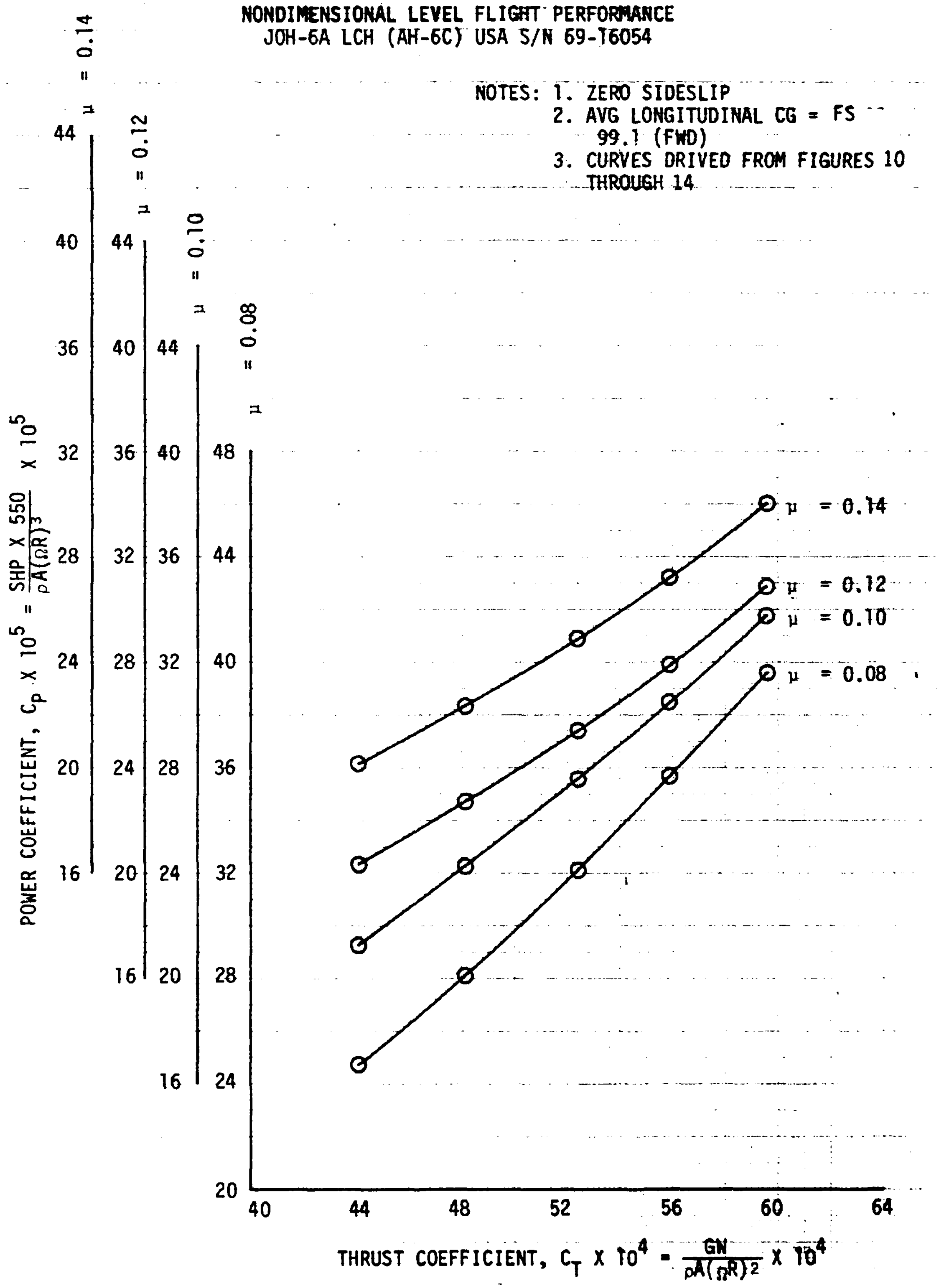


FIGURE 9
NONDIMENSIONAL LEVEL FLIGHT PERFORMANCE
JOH-6A LCH (AH-6C) USA S/N 69-16054

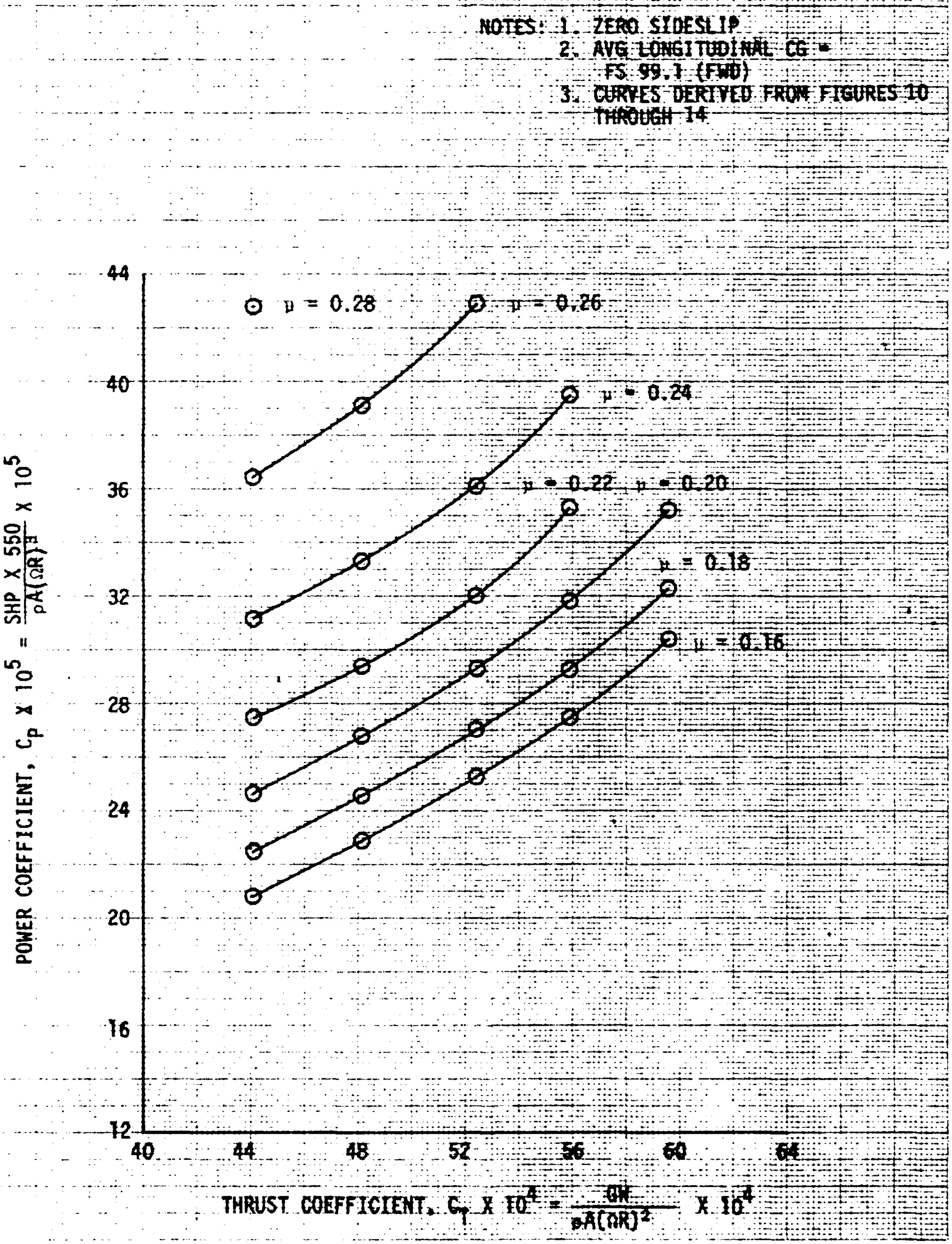
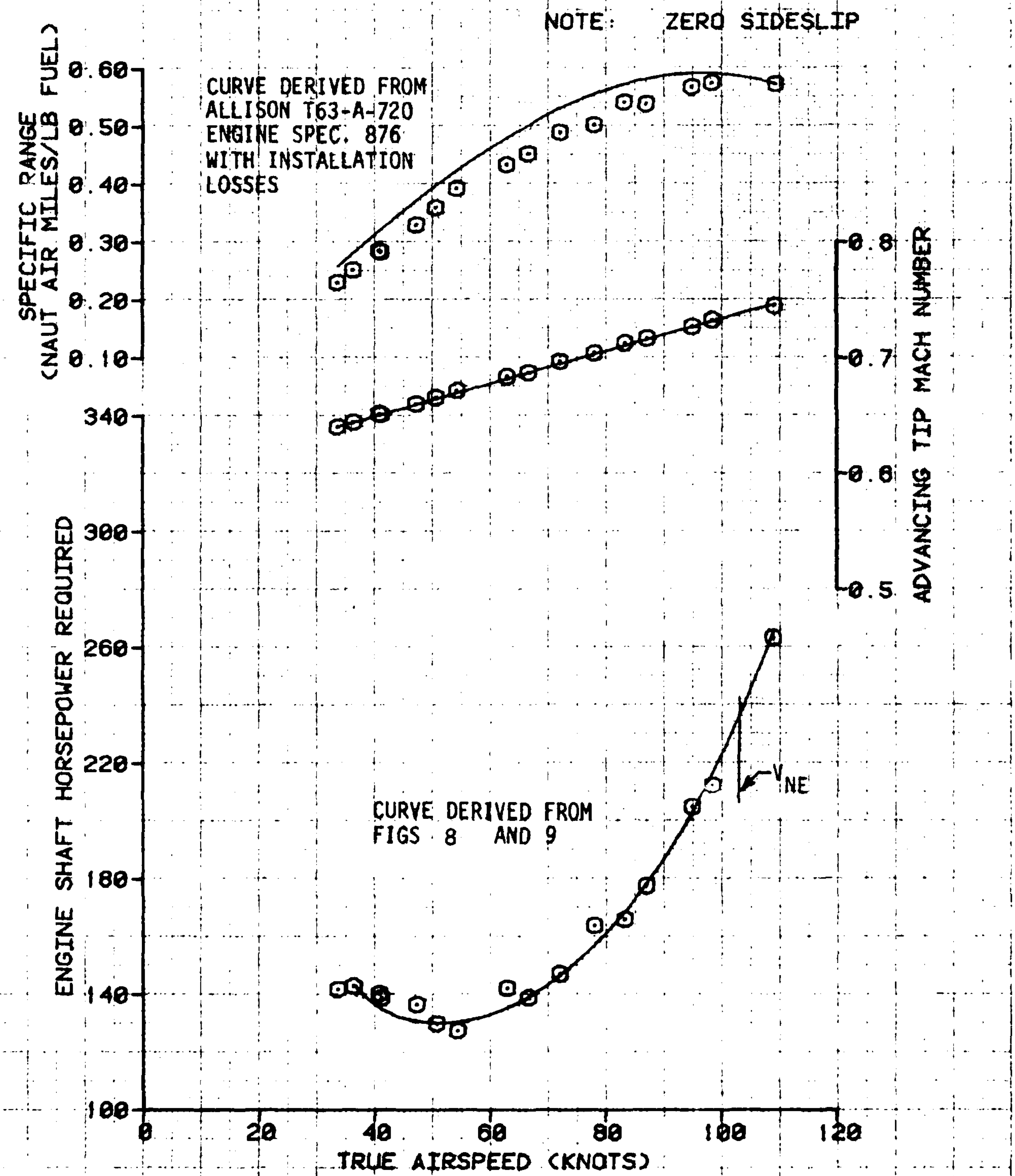


FIGURE 10
LEVEL FLIGHT PERFORMANCE
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG CT
2360	99.3 (FWD)	0.5 RT	2420	22.0	483	0.004410



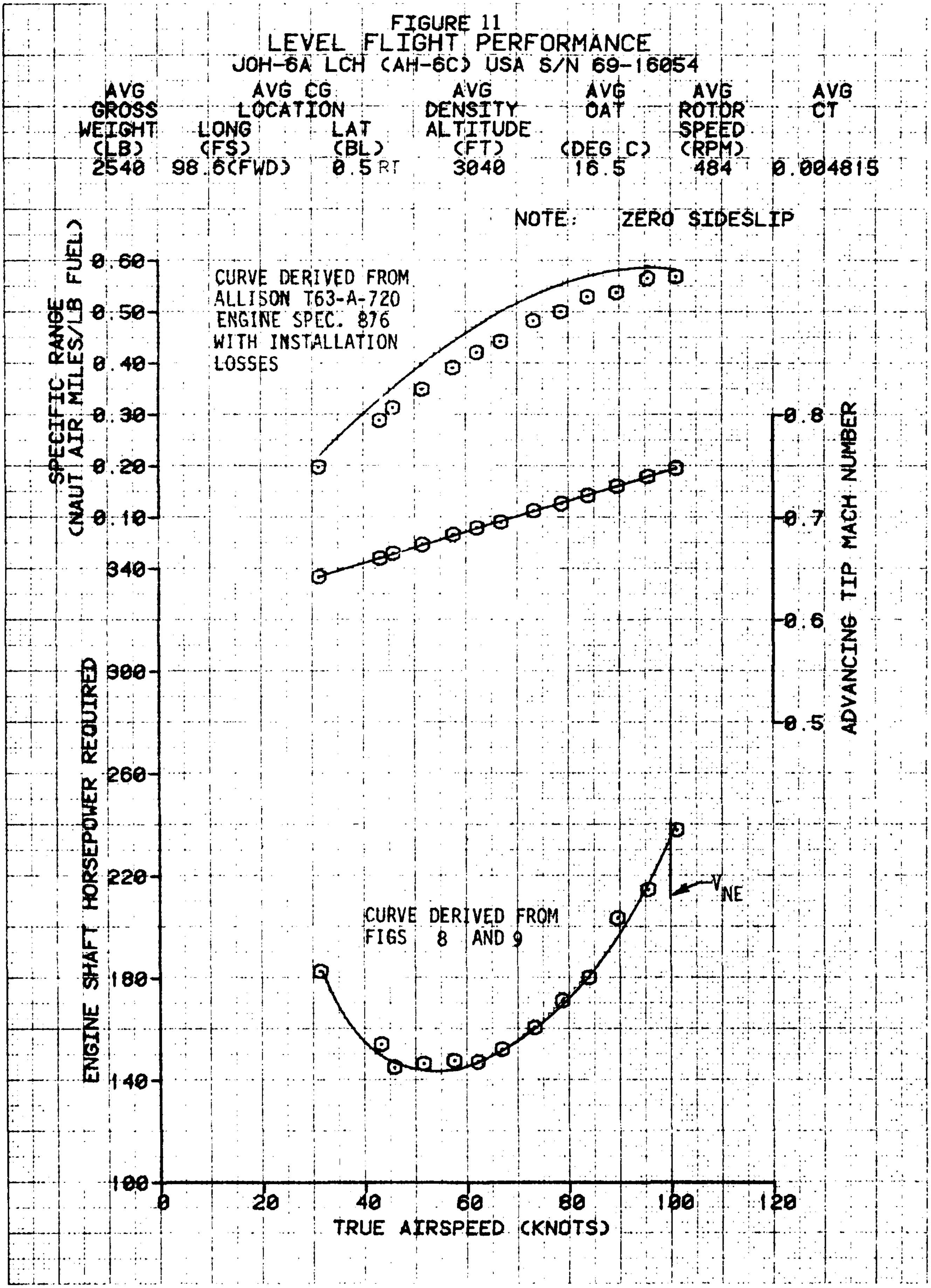


FIGURE 11
LEVEL FLIGHT PERFORMANCE
JOH-6A LCH (AH-6C) USA S/N 69-16054
AVG GROSS WEIGHT (LB) 2540
AVG CG LOCATION LONG (FS) 98.6(FWD)
LAT (BL) 0.5 RT
AVG DENSITY ALTITUDE (FT) 3040
AVG OAT (DEG C) 16.5
AVG ROTOR SPEED (RPM) 484
AVG CT 0.004815
NOTE: ZERO SIDESLIP
CURVE DERIVED FROM ALLISON T63-A-720 ENGINE SPEC. 876 WITH INSTALLATION LOSSES
SPECIFIC RANGE (NAUT AIR MILES/LB FUEL)
ADVANCING TIP MACH NUMBER
ENGINE SHAFT HORSEPOWER REQUIRED
CURVE DERIVED FROM FIGS 8 AND 9
V_{NE}
TRUE AIRSPEED (KNOTS)

FIGURE 12
LEVEL FLIGHT PERFORMANCE
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG CT
2660	99.2(FWD)	0.5 RT	4060	19.0	482	0.005243

NOTE: ZERO SIDESLIP

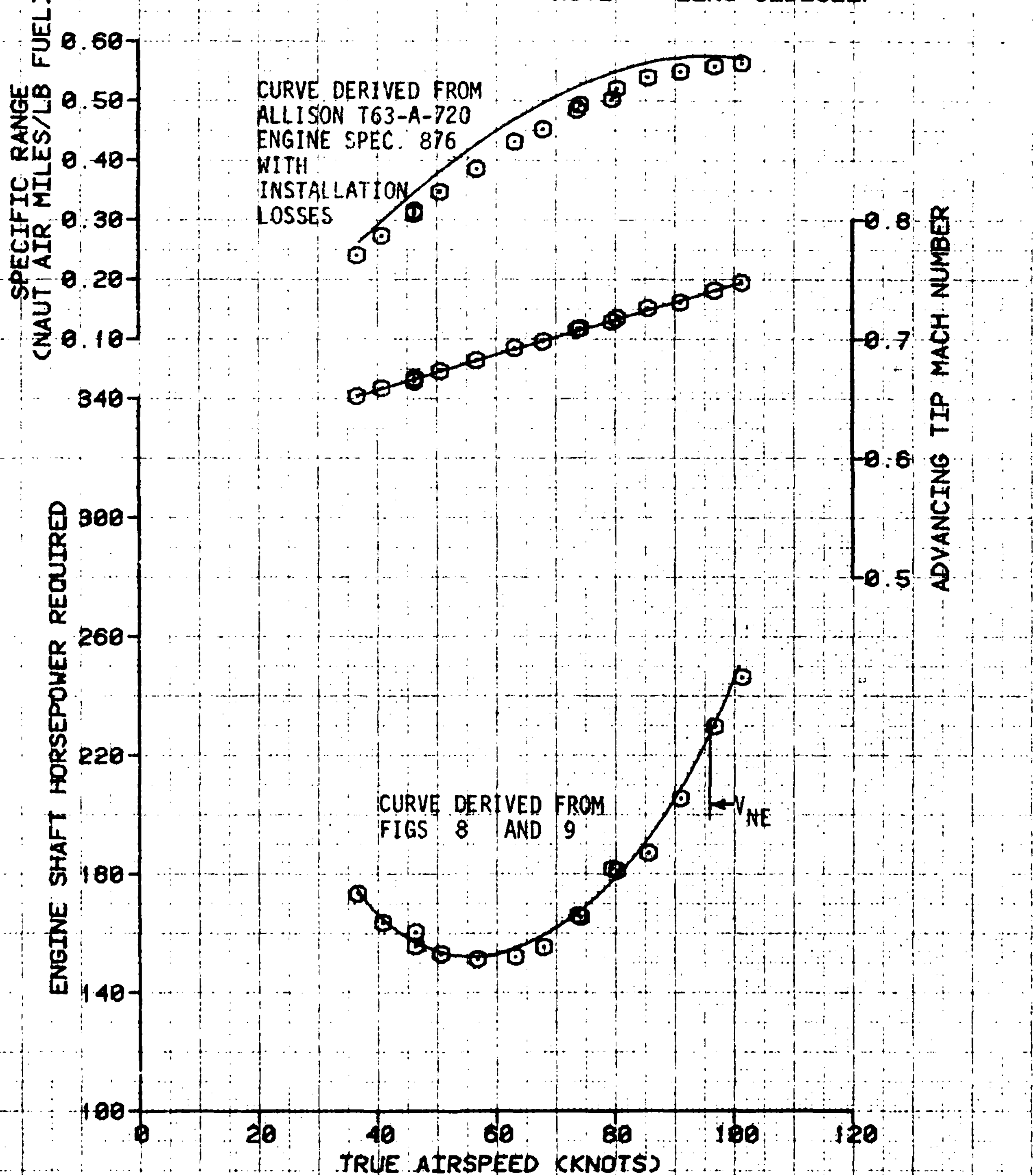


FIGURE 13

LEVEL FLIGHT PERFORMANCE

JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG CT
2620	99.3(FWD)	0.5 RT	6800	17.5	483	0.005589

NOTE: ZERO SIDESLIP

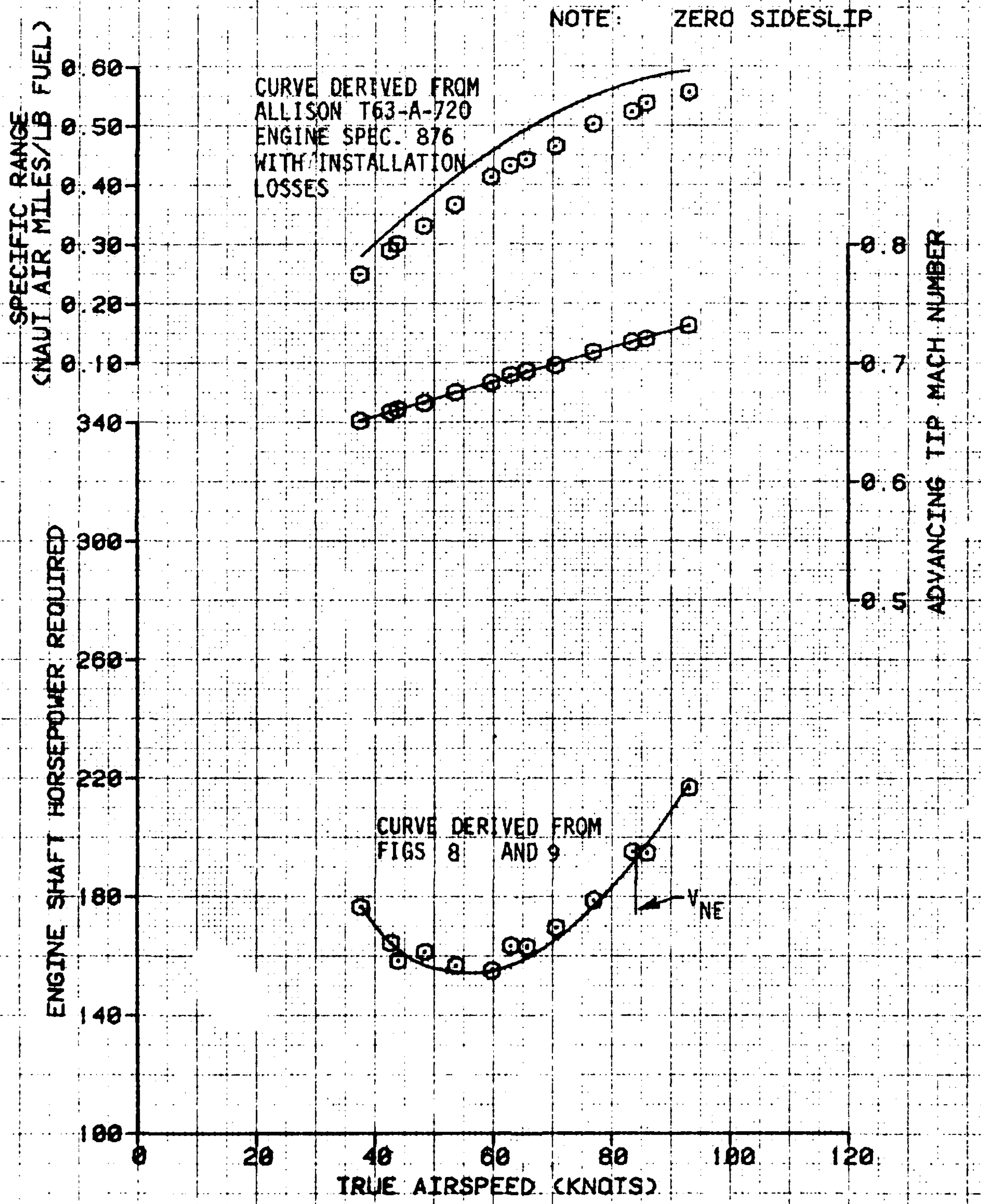


FIGURE 14
LEVEL FLIGHT PERFORMANCE
JOH-6A LCH (AH-6C) USA S/N 65-18034

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG CT
2620	99.2(FWD)	0.5 RT	9600	22.0	434	0.005958

NOTE: ZERO SIDESLIP

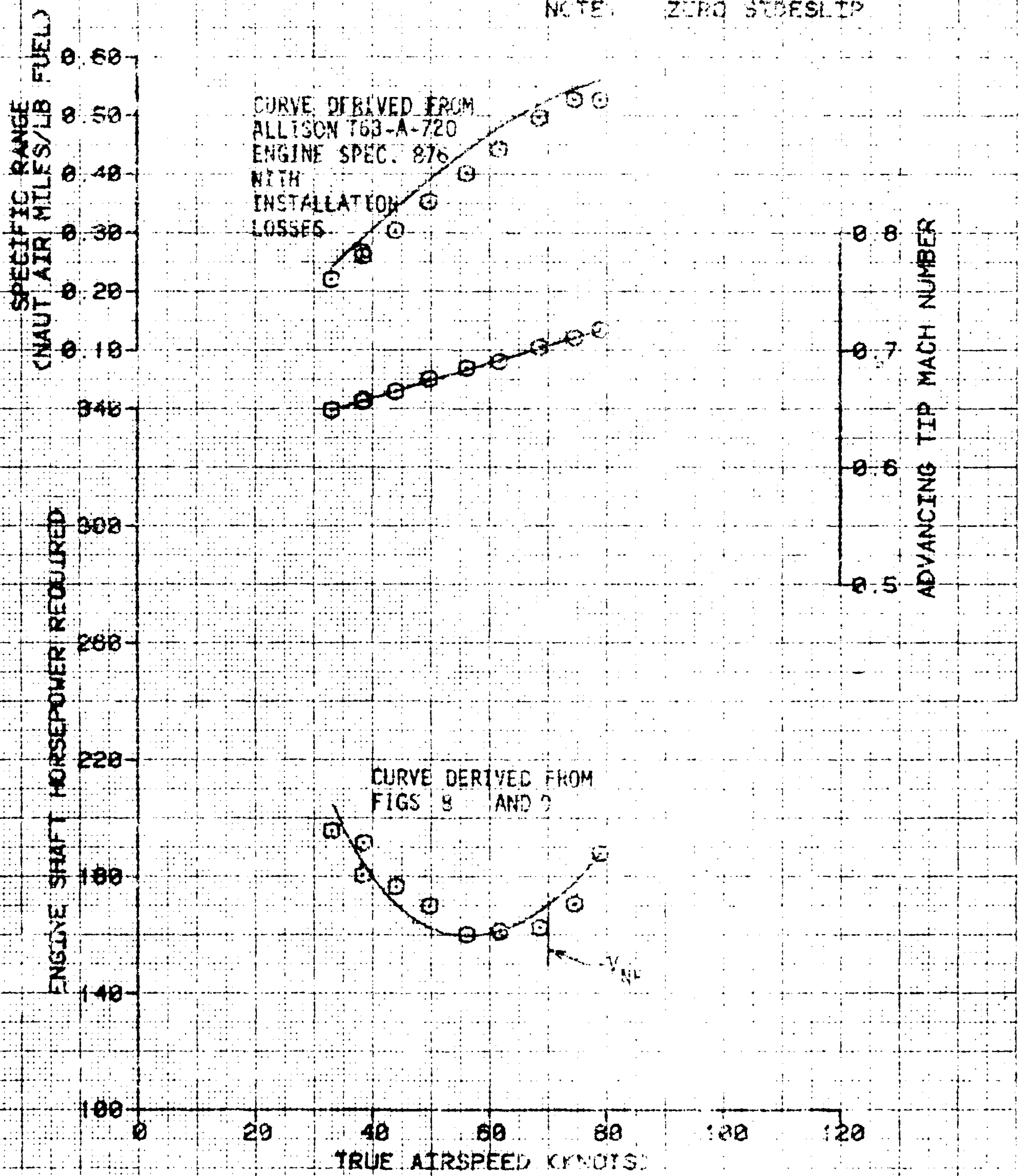


FIGURE 15
LEVEL FLIGHT RANGE SUMMARY
JOH-6A LCH (AH-6C) USA S/N 69-16054

NOTES: 1. DATA DERIVED FROM FIGURES 8 AND 9
2. FUEL FLOW BASED ON ALLISON 250-C20B ENGINE MODEL SPECIFICATION 876 DATED, 12 SEPTEMBER 1975
3. RECOMMENDED CRUISE TRUE AIRSPEED LIMITED TO V_{NE}

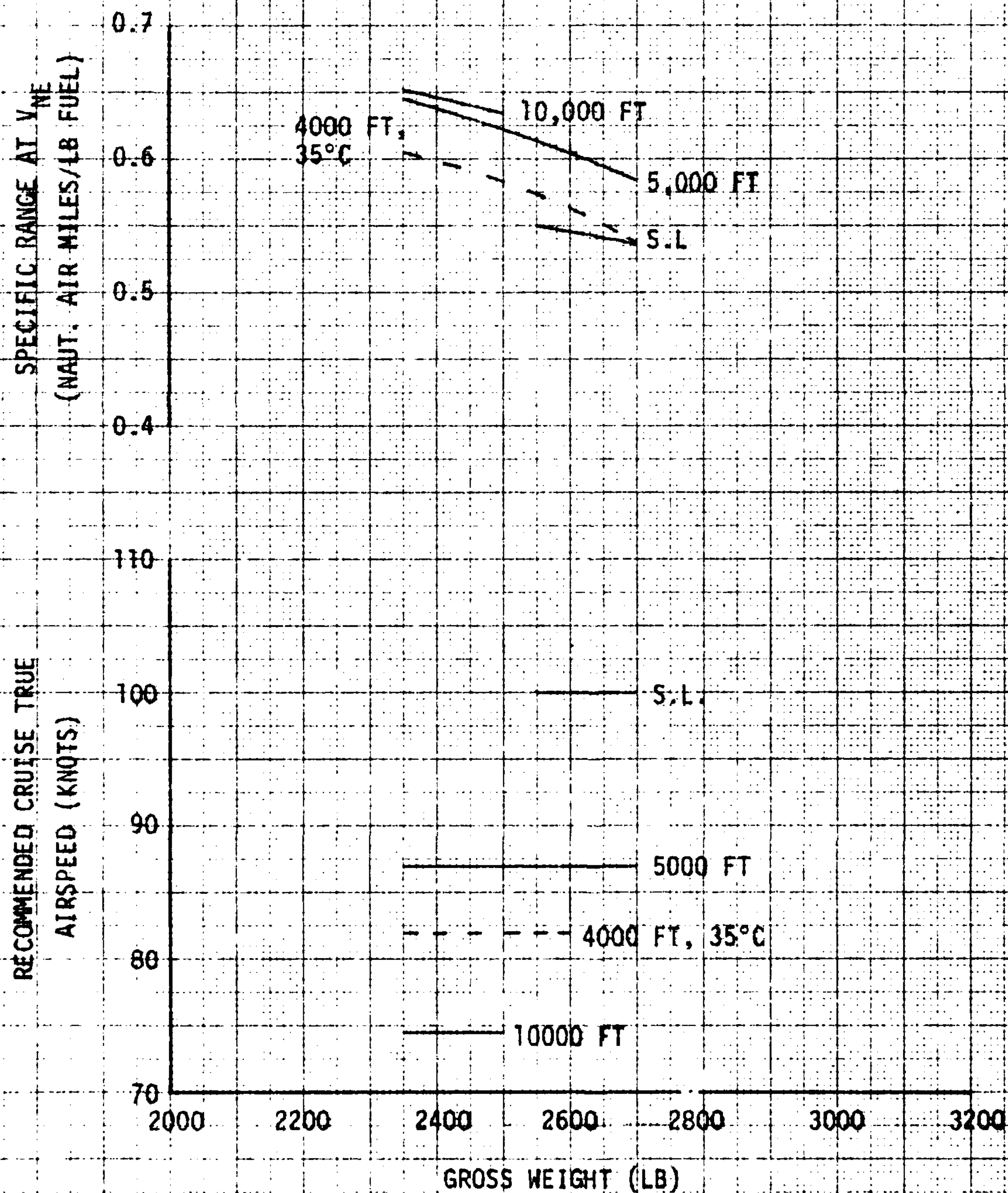


FIGURE 10
LEVEL FLIGHT ENDURANCE SUMMARY
[illegible] USA S/N 69-16054

NOTES: 1. DATA DERIVED FROM FIGURES 8 AND 9
2. FUEL FLOW BASED ON ALLISON 250-C20B ENGINE MODEL SPECIFICATION 876 DATED [illegible] SEPTEMBER [illegible]

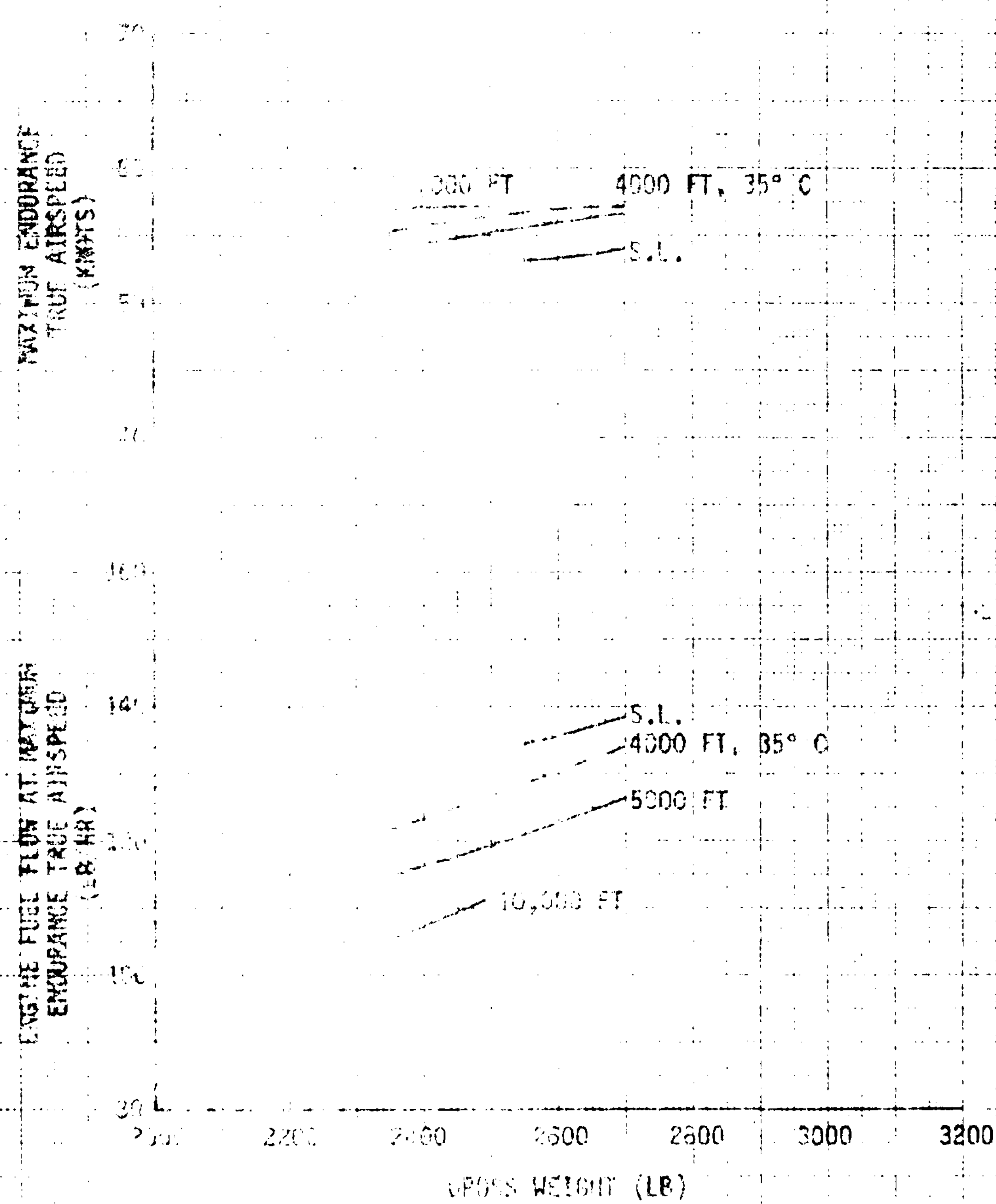


FIGURE 17
AUTOROTATIONAL DESCENT PERFORMANCE
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)
2490	98.7(FWD)	0.5 RT	7470	22.0	485

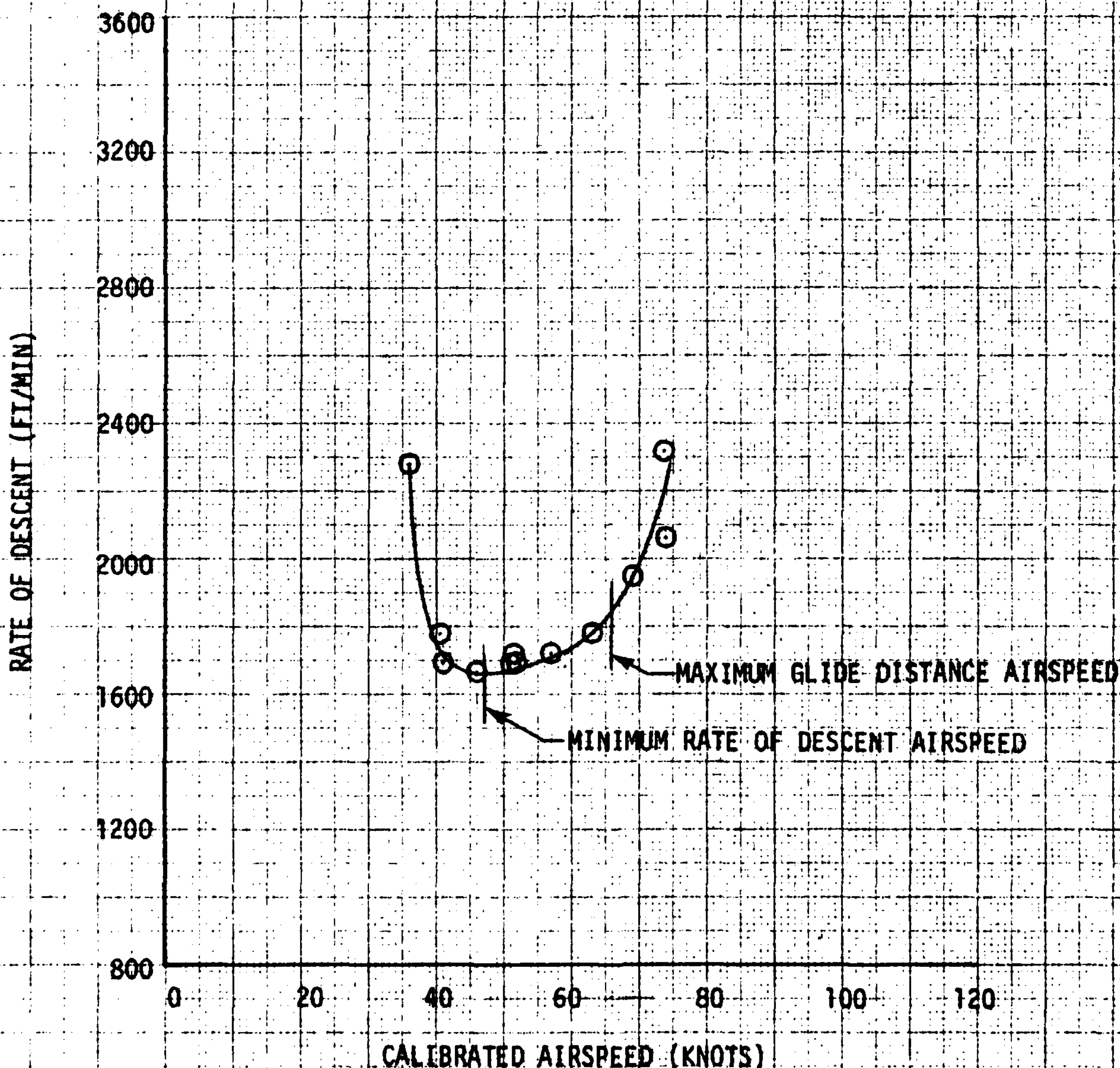


FIGURE 18
AUTOROTATIONAL DESCENT PERFORMANCE
JOH-6A LOH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG CALIBRATED AIRSPEED (KT)
2530	99.1(FWD)	0.5RT	8690	22.0	47

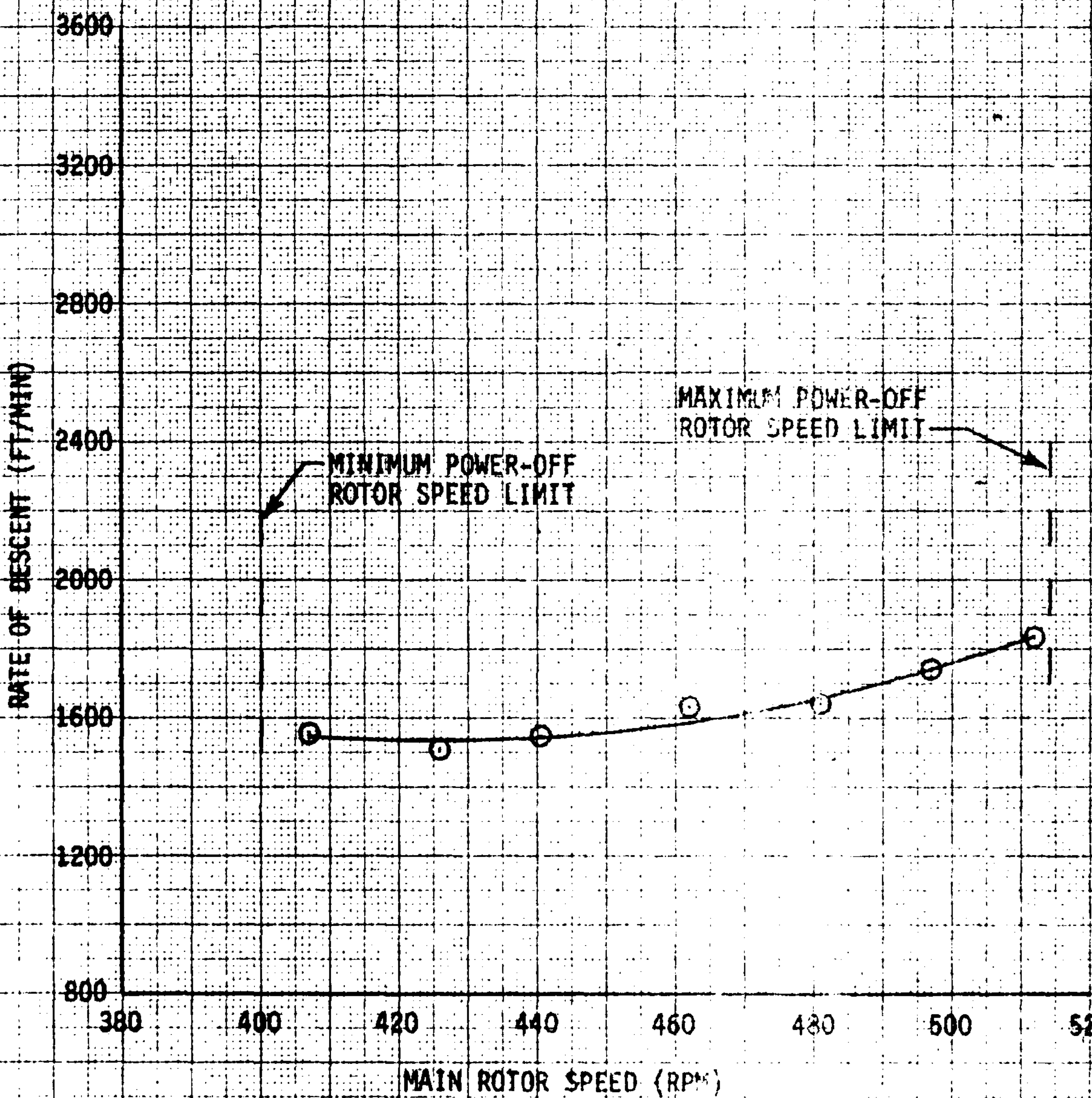


FIGURE 19
CONTROL POSITIONS IN TRIMMED FORWARD FLIGHT
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	AVG C_T	FLIGHT CONDITION
2360	99.3(FWD)	0.5 RT	2420	22.0	483	0.004410	LEVEL

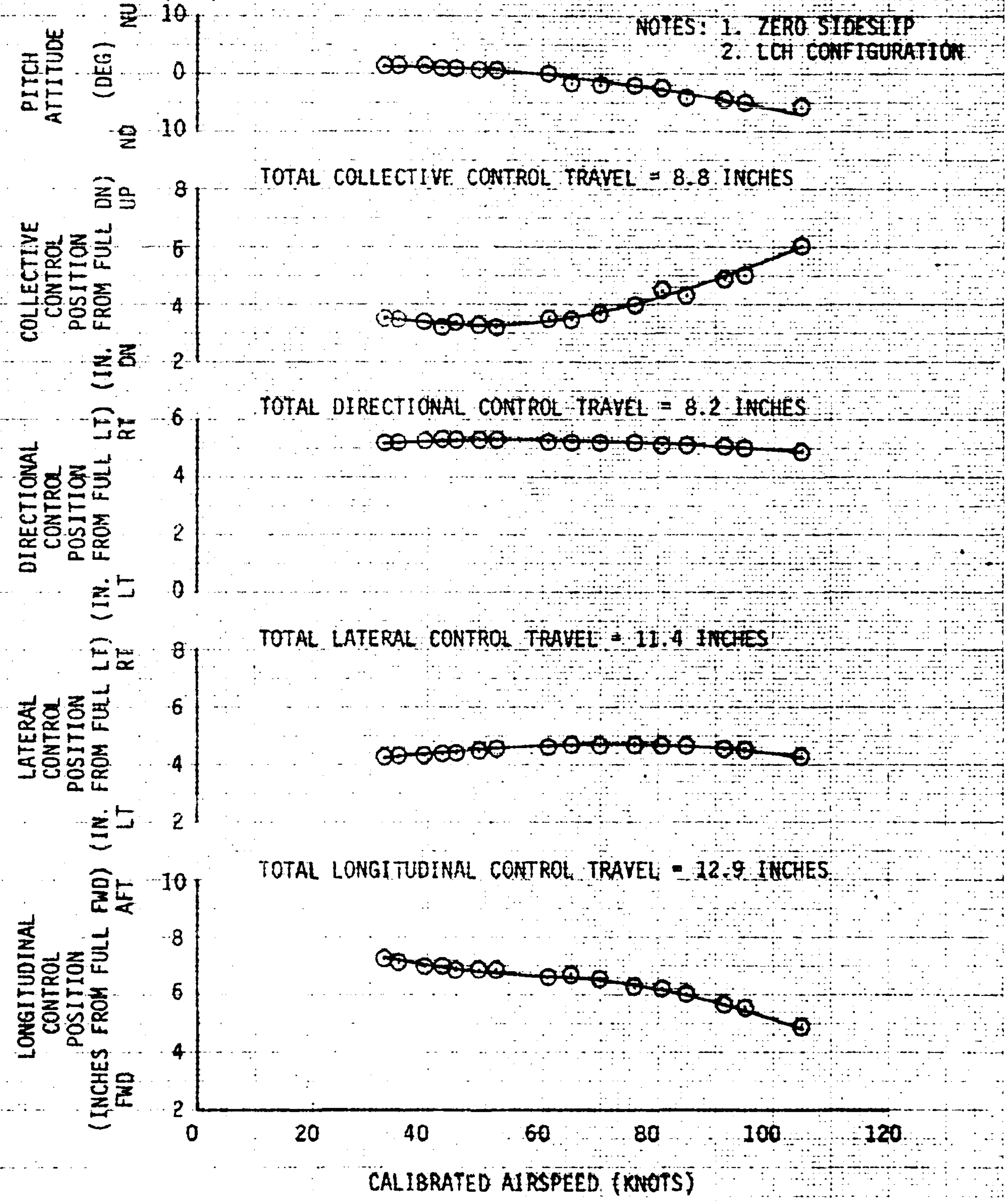


FIGURE 20

CONTROL POSITIONS IN TRIMMED FORWARD FLIGHT

JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	AVG C_T	FLIGHT CONDITION
[illegible]	[illegible]	0.5 RT	3040	16.5	484	0.004815	LEVEL

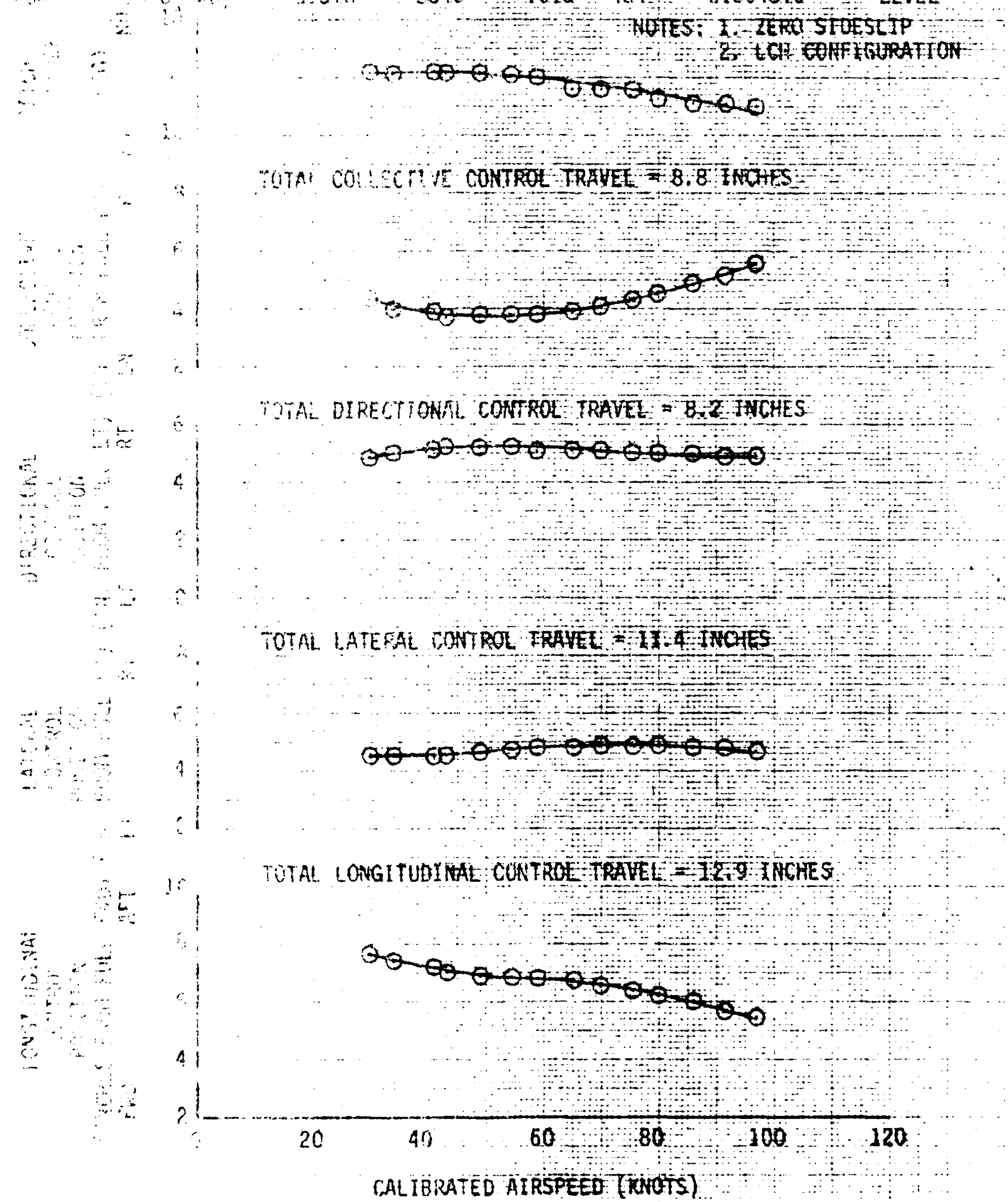


FIGURE 21
CONTROL POSITIONS IN TRIMMED FORWARD FLIGHT
JOH-6A LCH (AH-6C) USA S/N 89-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	AVG C_T	FLIGHT CONDITION
2660	99.2(FWD)	0.5 RT	4060	19.0	482	0.005243	LEVEL

NOTES: 1. ZERO SIDESLIP
2. LCH CONFIGURATION

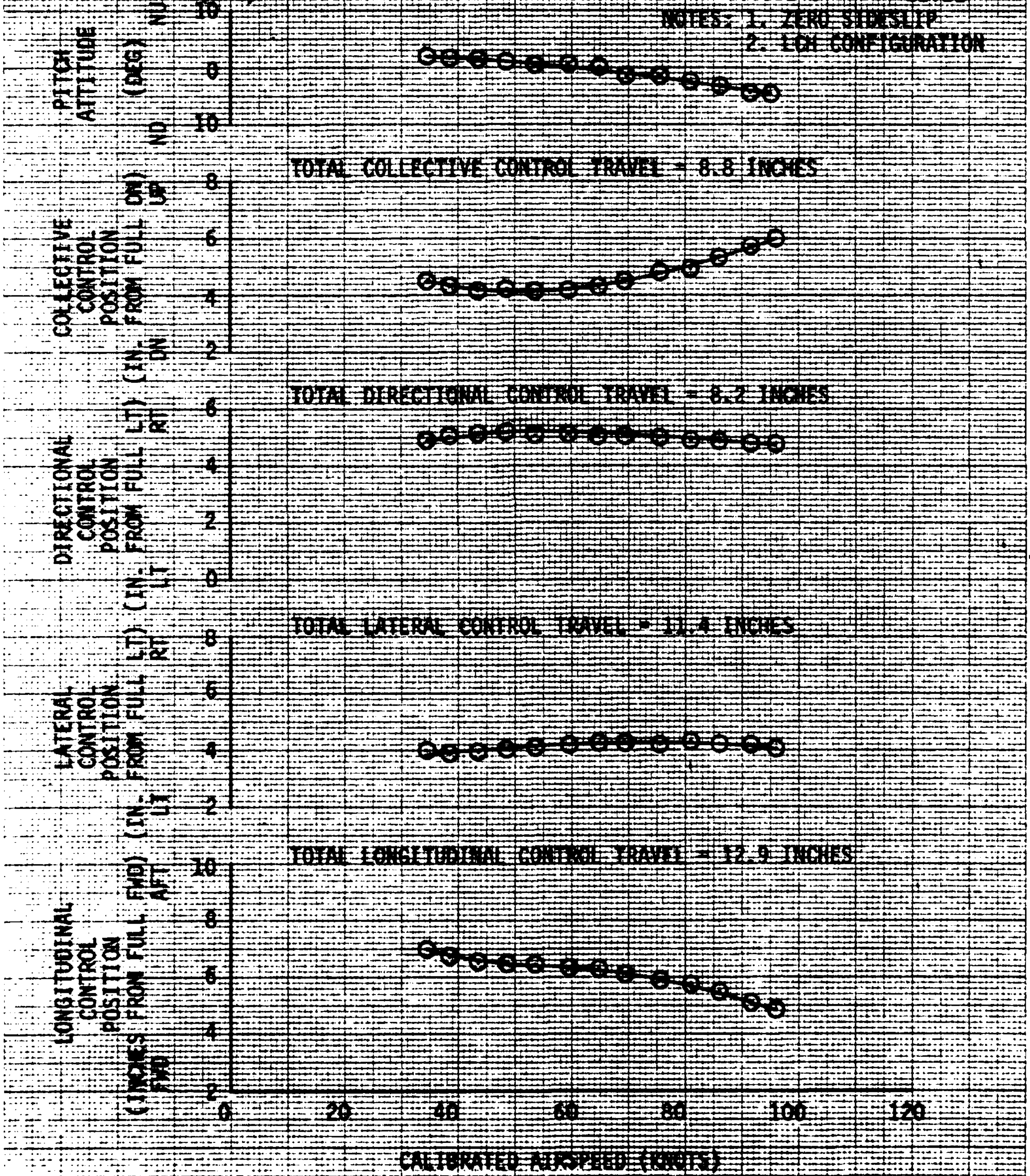


FIGURE 22
CONTROL POSITIONS IN TRIMMED FORWARD FLIGHT
JOH-6A LCH (AH-6C) USA S/N 69-16054

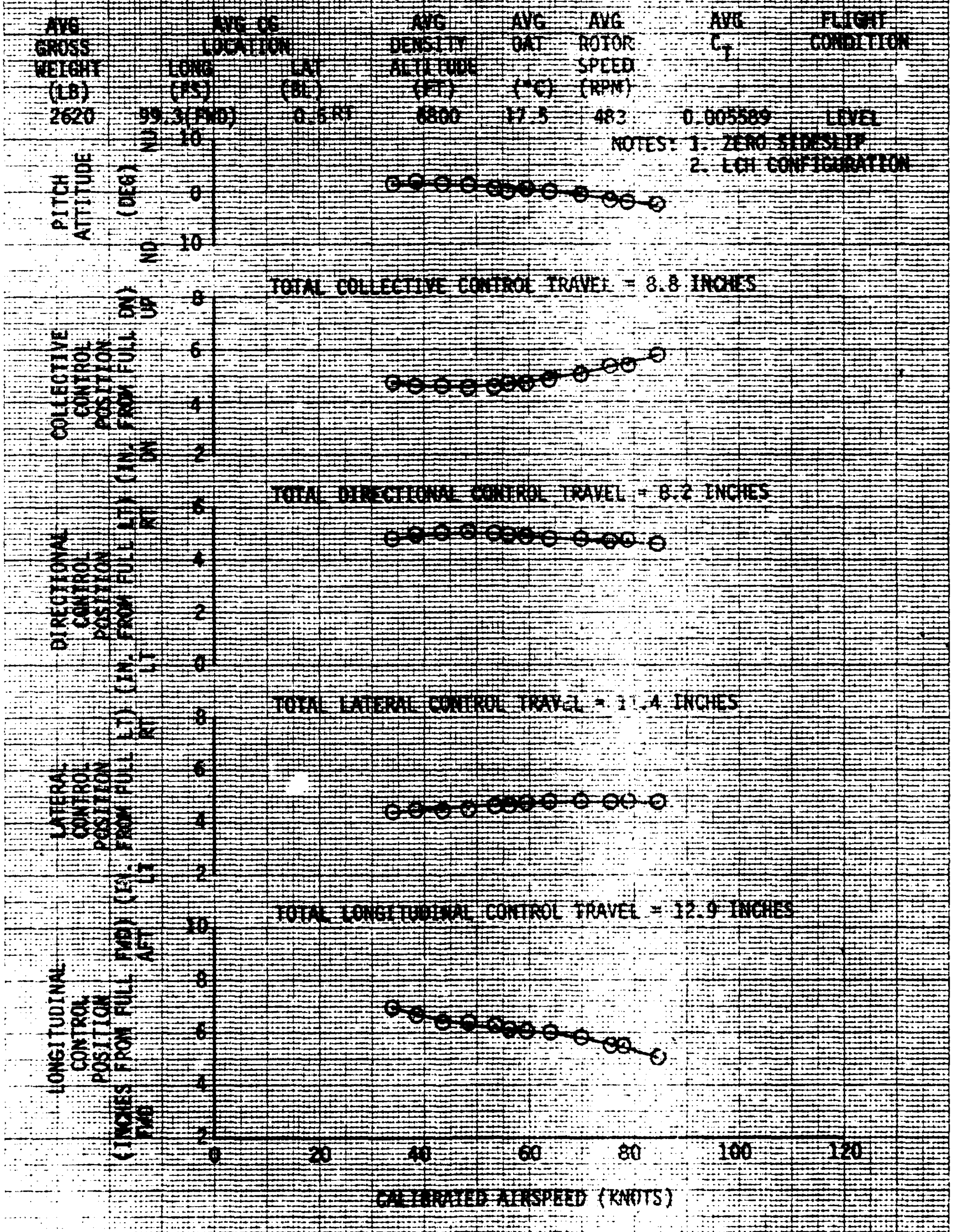


FIGURE 23
CONTROL POSITIONS IN TRIMMED FORWARD FLIGHT
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	AVG C_T	FLIGHT CONDITION
2620	99.2(FWD)	0.5 RT	9000	22.0	484	0.005958	LEVEL

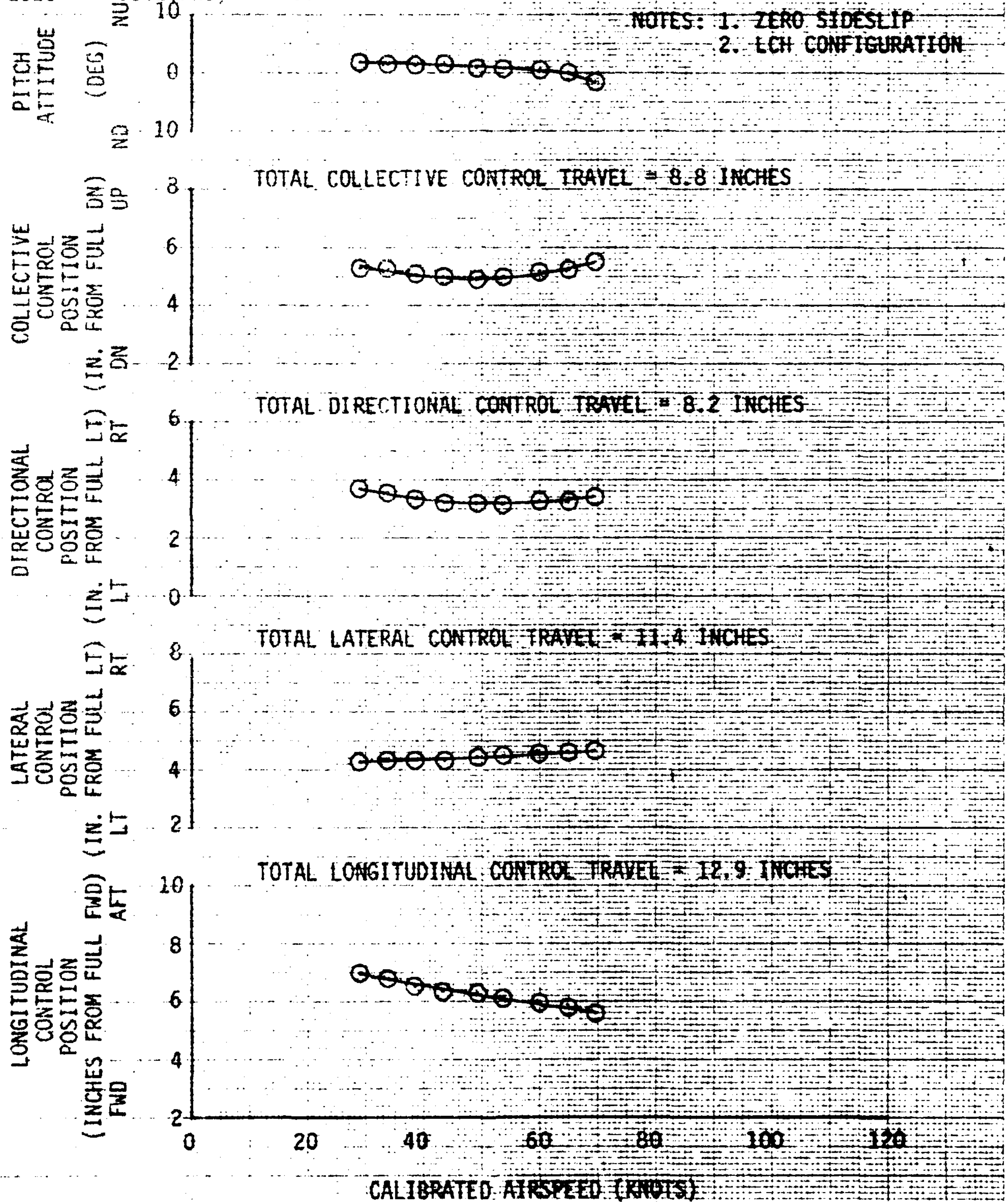


FIGURE 24
CONTROL POSITIONS IN TRIMMED FORWARD FLIGHT
JOH-6A LCH (AH-6C) USA S/N 69-16054

SYM	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
○	2590	99.1 (FWD)	0.5 RT	7060	27.0	483	CLIMB
□	2590	99.1 (FWD)	0.5 RT	7080	26.0	483	AUTOROTATION

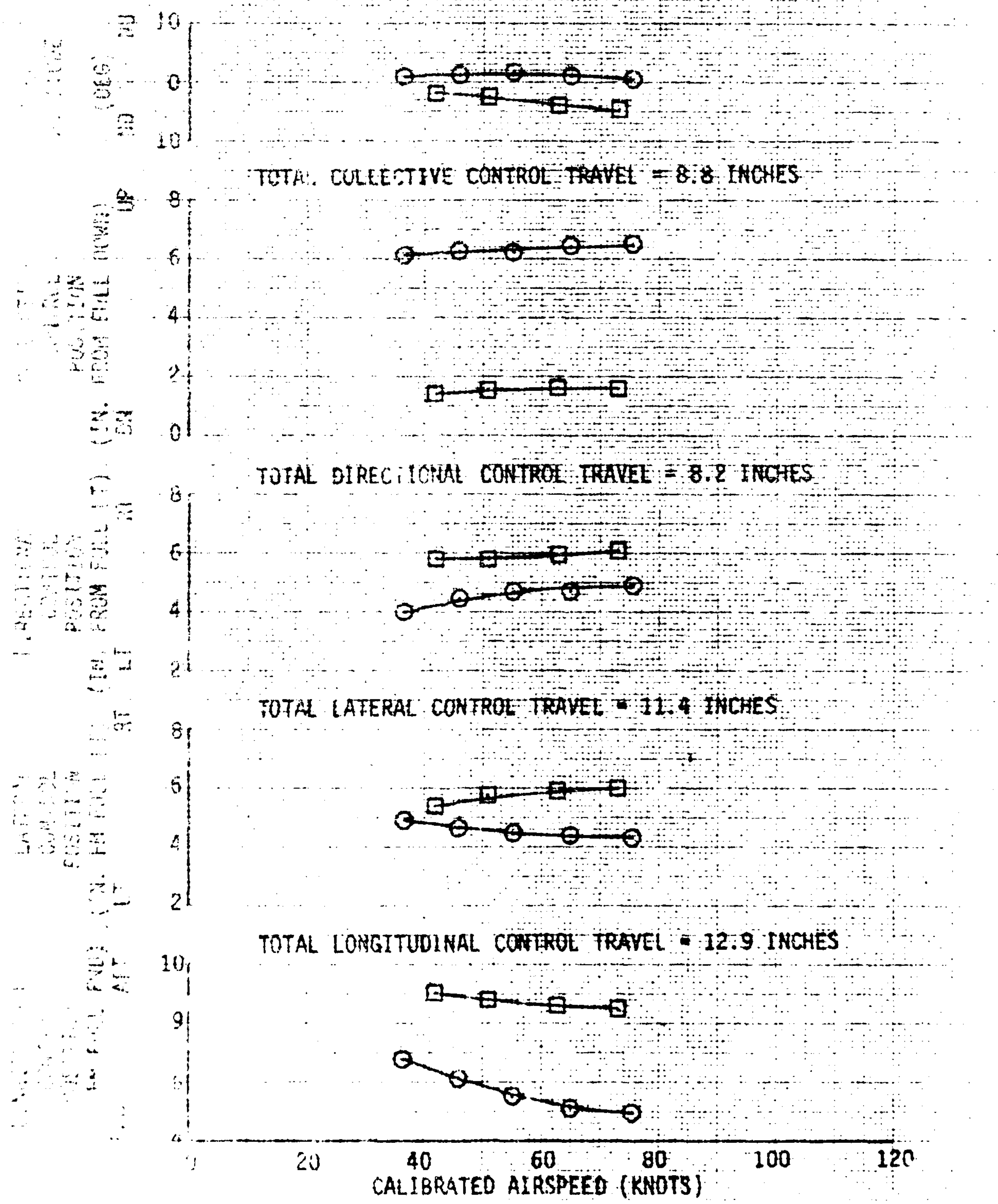


FIGURE 25
COLLECTIVE-FIXED STATIC LONGITUDINAL STABILITY
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
2650	100.0(FWD)	0.5 RT	6880	22.0	482	LEVEL

NOTE: SHADED SYMBOL DENOTES TRIM

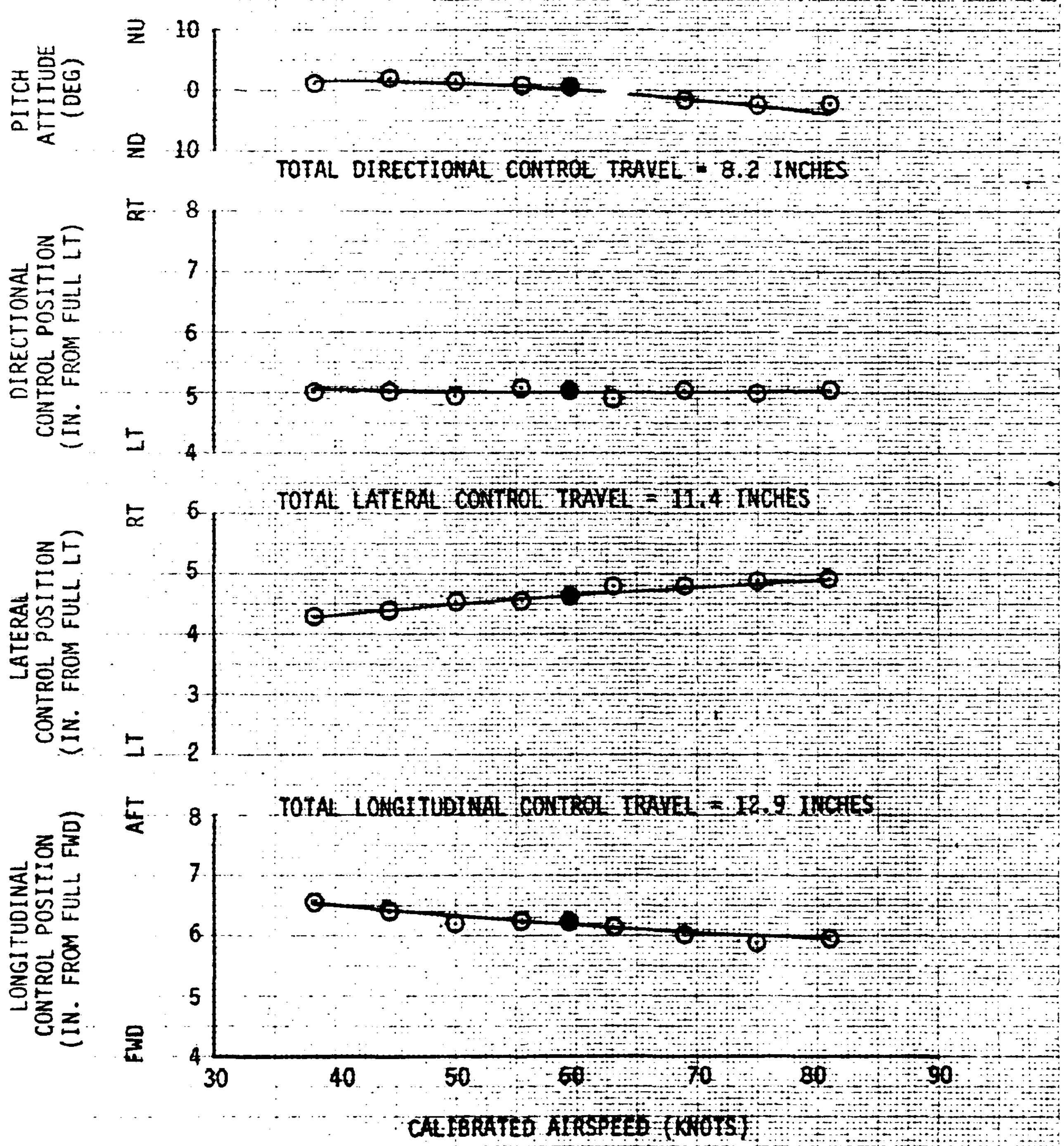


FIGURE 26
COLLECTIVE-FIXED STATIC LONGI[illegible]
JOH-6A LCH (AH-6C) USA S/[illegible]

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	[illegible]	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
2620	100.0 (FWD)	0.5 RT	7390	[illegible]	[illegible]33	LEVEL

NOTE: SHADED [illegible] DENOTES TRIM

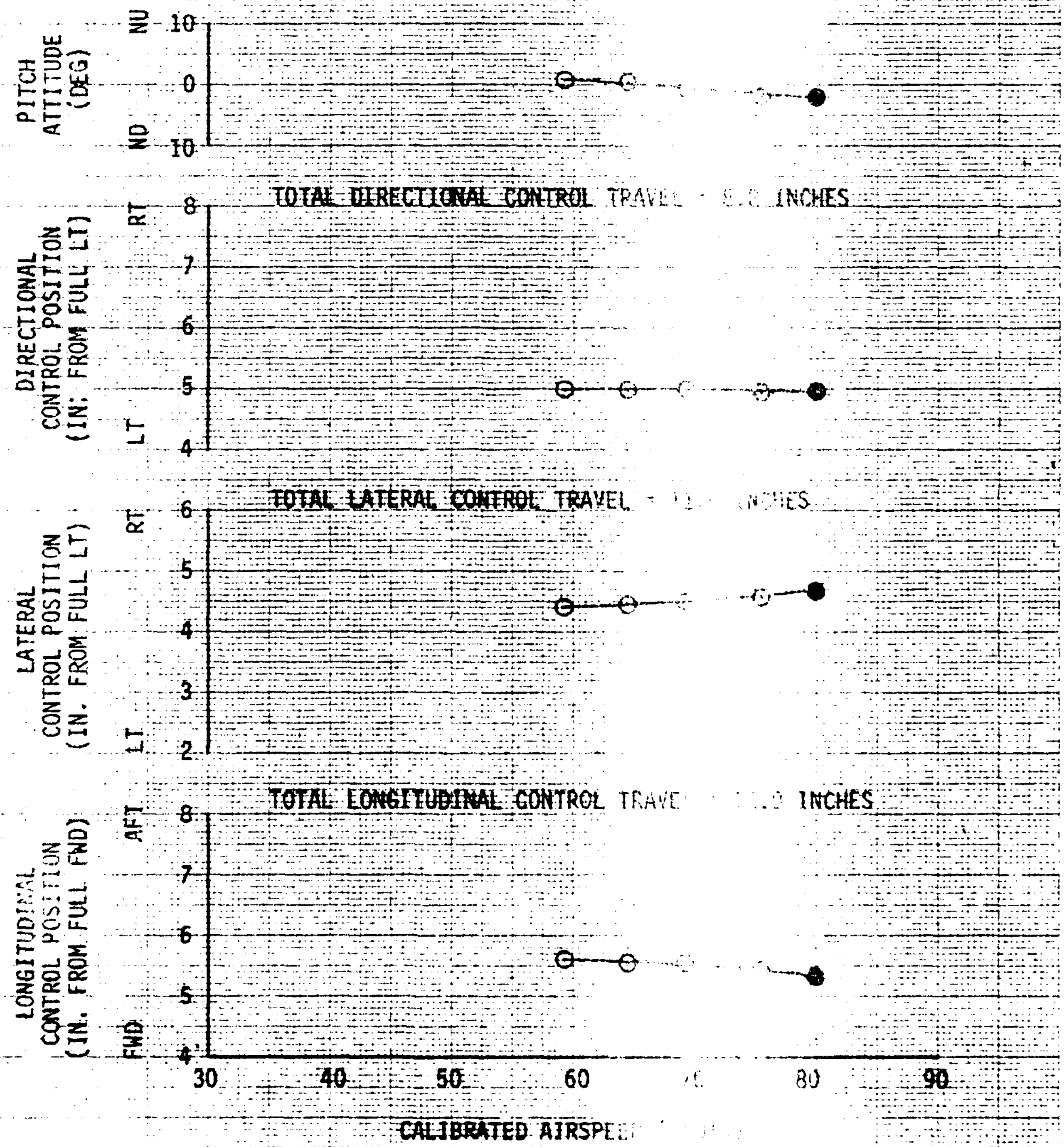


FIGURE 27

COLLECTIVE-FIXED STATIC LONGITUDINAL STABILITY

JOH-6A LCH (AH-6C) USA S/N 69-16054

SYM	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
○	2690	100.0(FWD)	0.5 RT	7980	21.0	482	CLIMB
□	2660	100.0(FWD)	0.5 RT	7250	21.5	481	AUTOROTATION

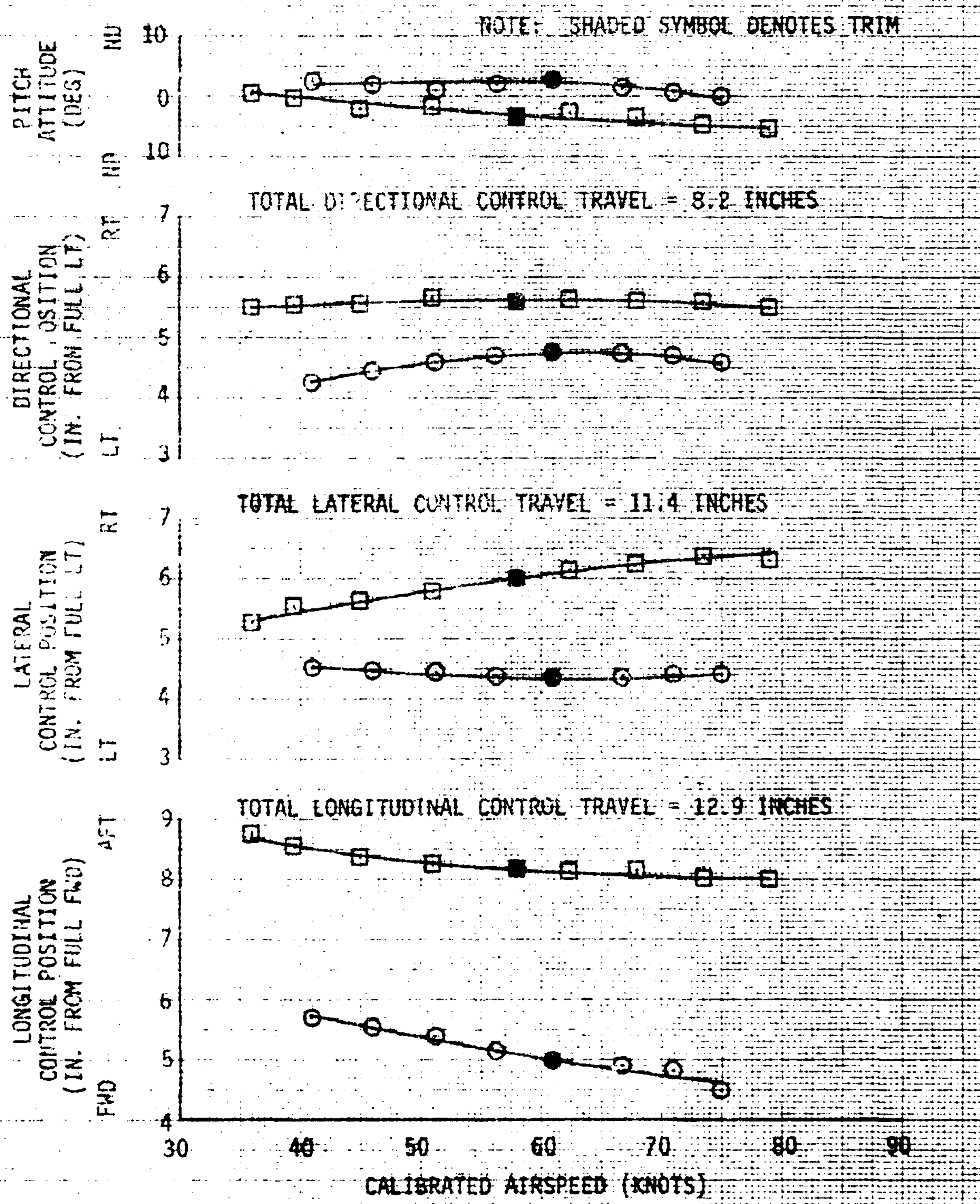


FIGURE [illegible]

[illegible] STATIC LONGITUDINAL STABILITY

[illegible]-6A [illegible] ([illegible]-6C) USA S/N 69-16054

SYM	[illegible]	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
○		[illegible]	[illegible]	7060	2[illegible].5	48[illegible]	CLIMB
□		[illegible]	[illegible]	[illegible]580	21.[illegible]	[illegible]	AUTOROTATION

NOTE: SHADED SYMBOL DENOTES TRIM

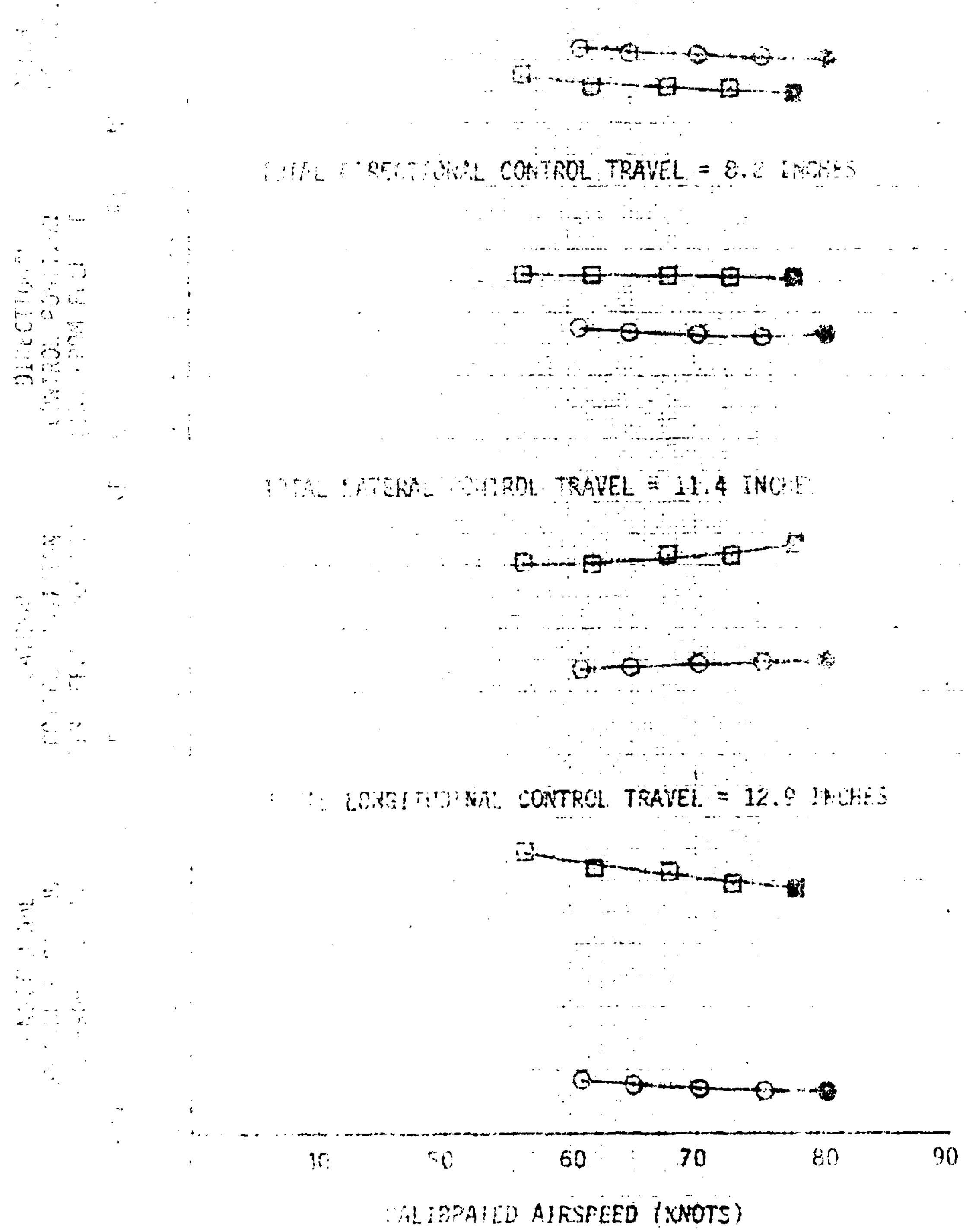
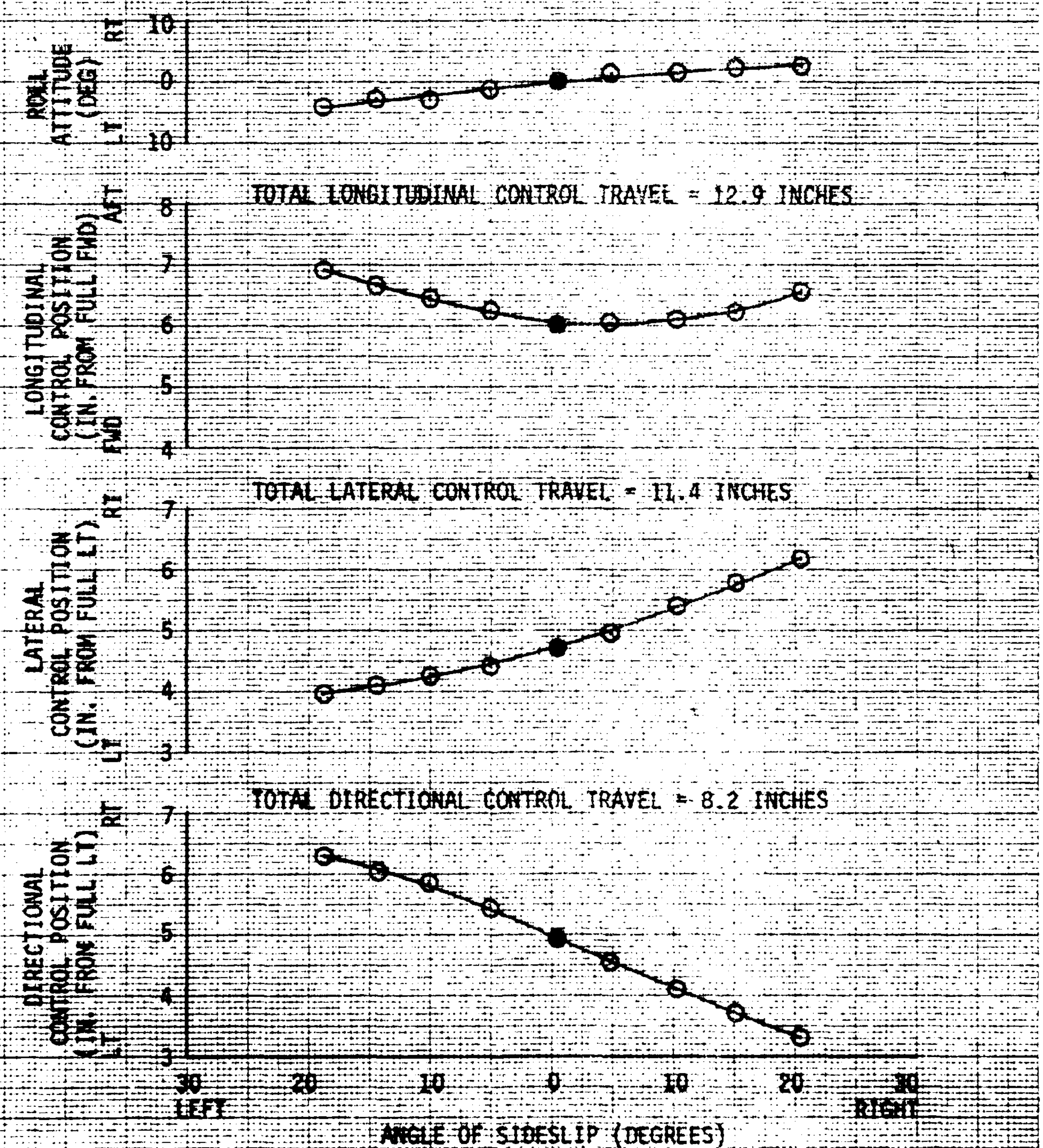


FIGURE 29
STATIC LATERAL-DIRECTIONAL STABILITY
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	AVG CALIBRATED AIRSPEED (KTS)	FLIGHT CONDITION
2590	100.0(FWD)	0.5 RT	7500	20.5	483	59	LEVEL

NOTE: SHADED SYMBOL DENOTES TRIM



STATIC LATE...
JOH-6A LOH (AH 6L) ...

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	FLIGHT CONDITION
2540	100.0(FWD)	0.5 RT	65[illegible]	LEVEL

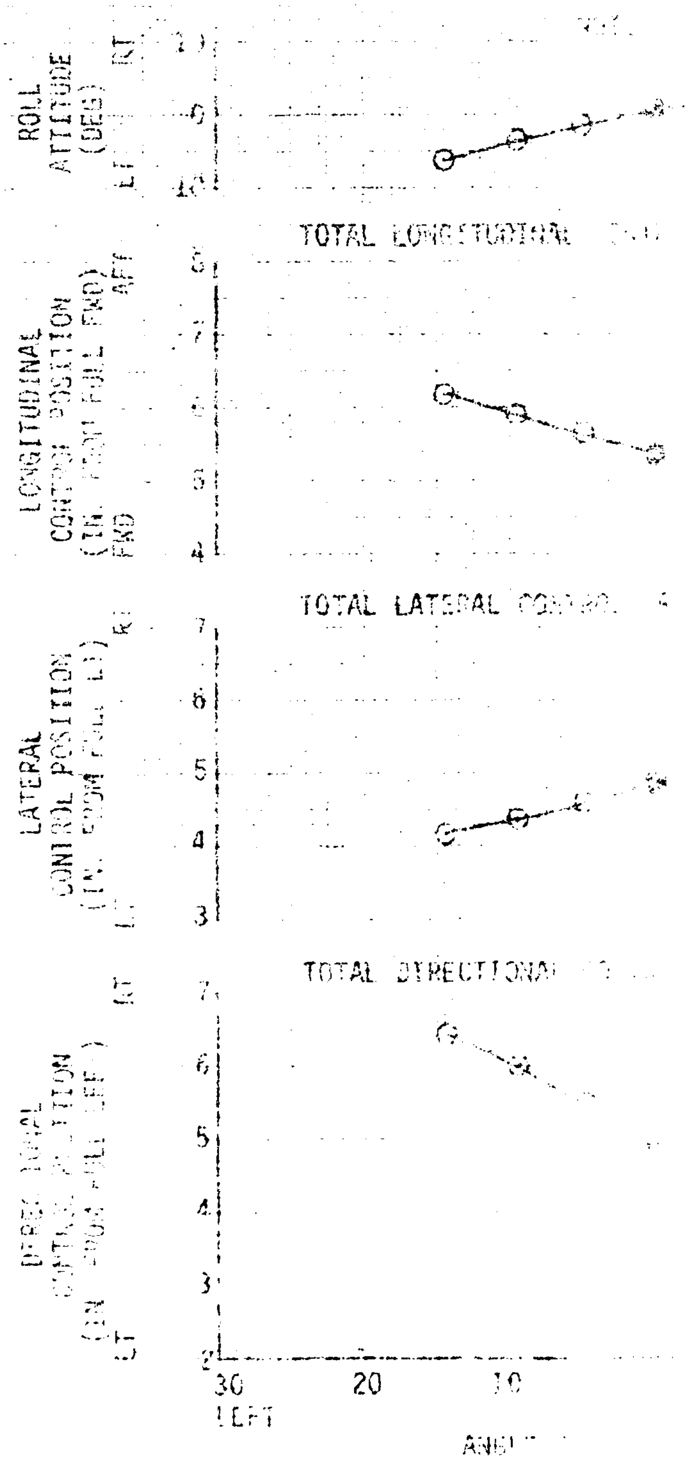


FIGURE 31
STATIC LATERAL-DIRECTIONAL STABILITY
JOH-6A LOH (AH-6C) USA S/N 69-16054

SYM	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	AVG CALIBRATED AIRSPEED (KTS)	FLIGHT CONDITION
○	2640	100.0(FWD)	0.5 RT	8970	18.5	483	60	CLIMB
□	2610	100.5(FWD)	0.5 RT	7790	20.5	482	56	AUTOROTATION

NOTE: SHADED SYMBOL DENOTES TRIM

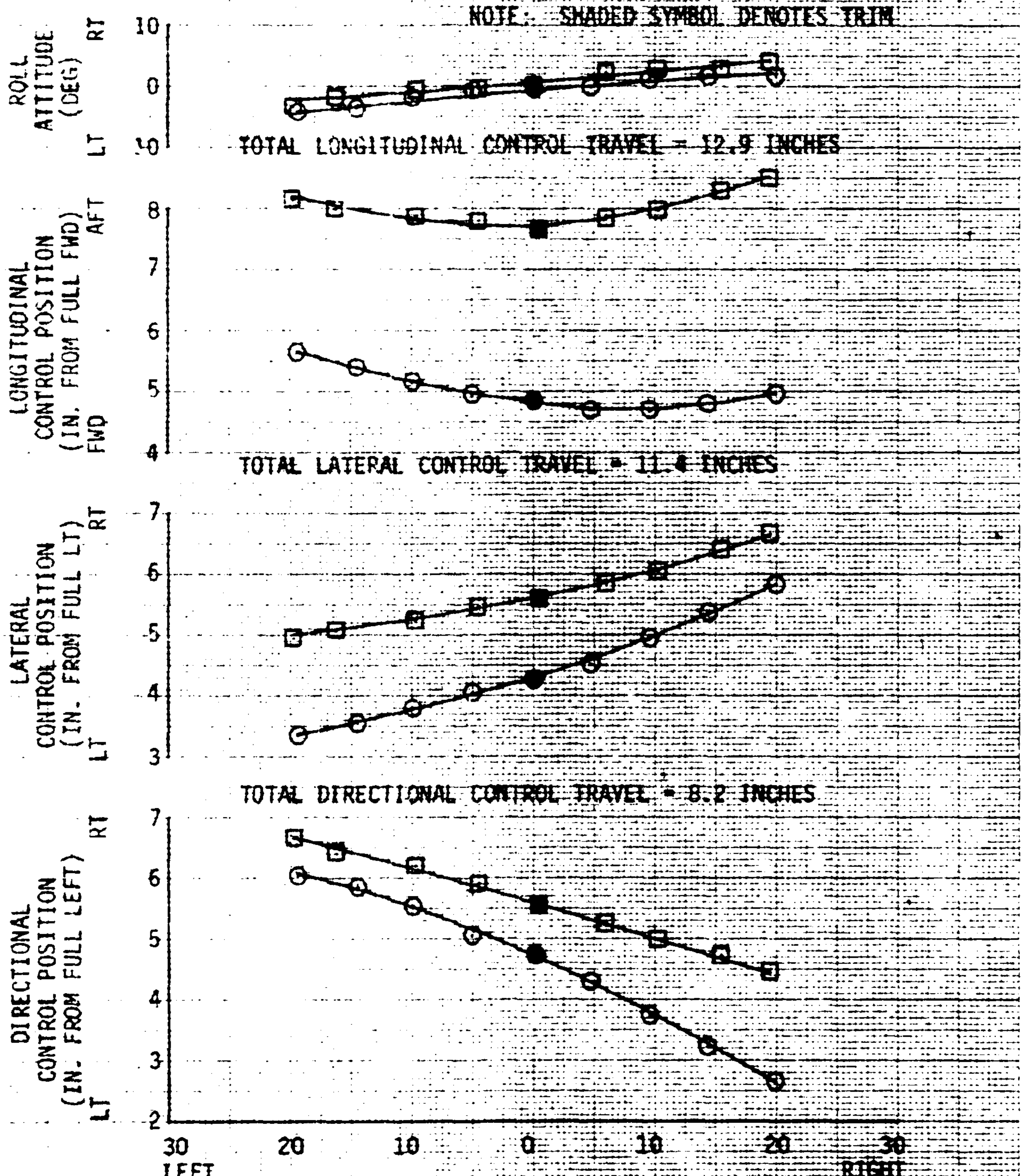


FIGURE 32
STATIC LATERAL-DIRECTIONAL STABILITY
JOH-6A LCH (AH-6C) USA S/N 69-16054

SYM	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	AVG CALIBRATED AIRSPEED (KTS)	FLIGHT CONDITION
○	2610	100.4(FWD)	0.5 RT	7680	22.0	414	75	CLIMB
□	2570	100.5(FWD)	0.5 RT	7200	22.0	483	73	AUTOROTATION

NOTE: SHADED SYMBOL DENOTES TRIM

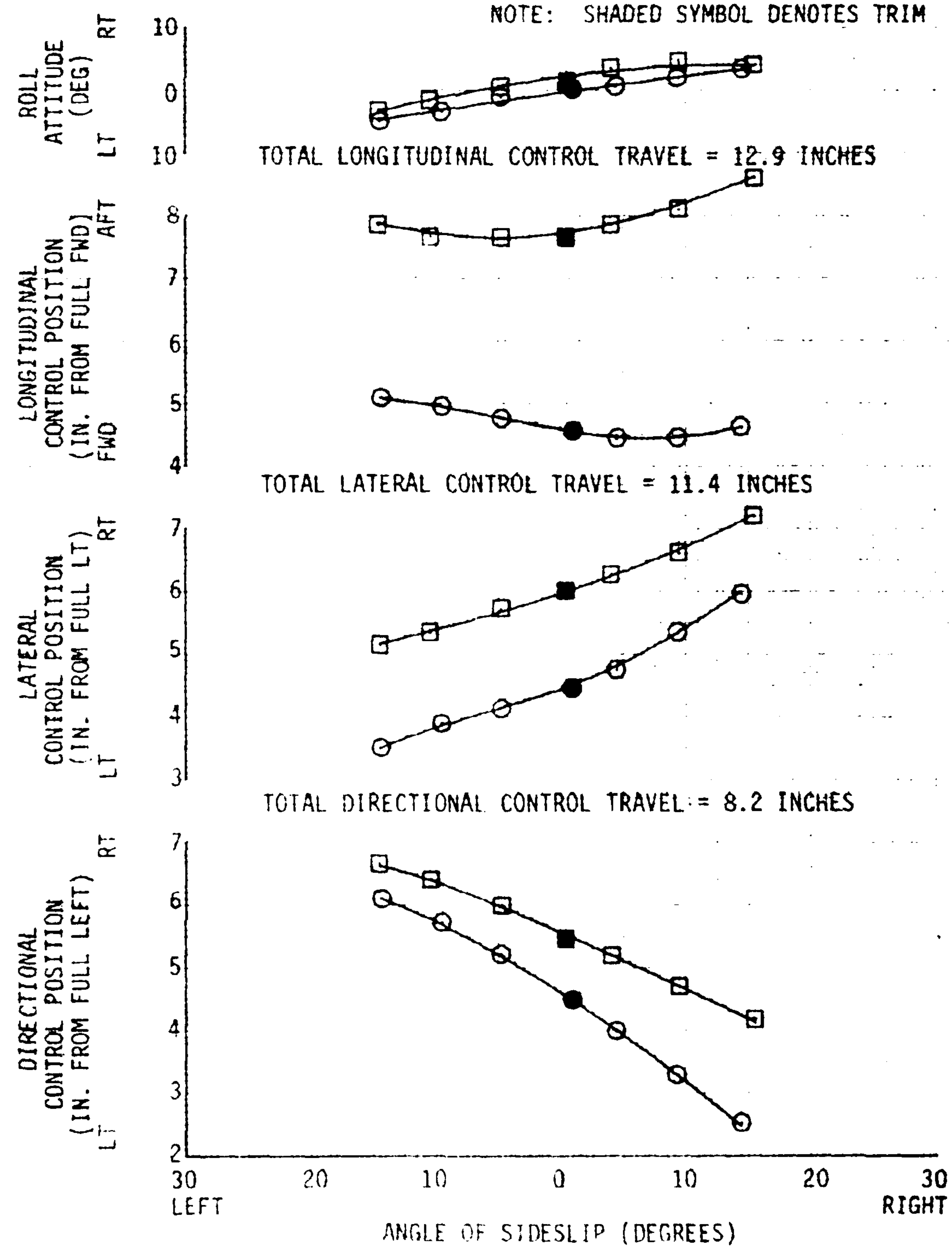


FIGURE 33
MANEUVERING STABILITY
JOH-6A LCH (AH-6C) USA S/N 69-16054

SYM	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	AVG CALIBRATED AIRSPEED (KTS)	FLIGHT CONDITION
○	2590	100.1(FWD)	0.5 RT	7440	13.0	488	59	RT TURN
□	2570	100.1(FWD)	0.5 RT	6980	13.5	486	60	LT TURN

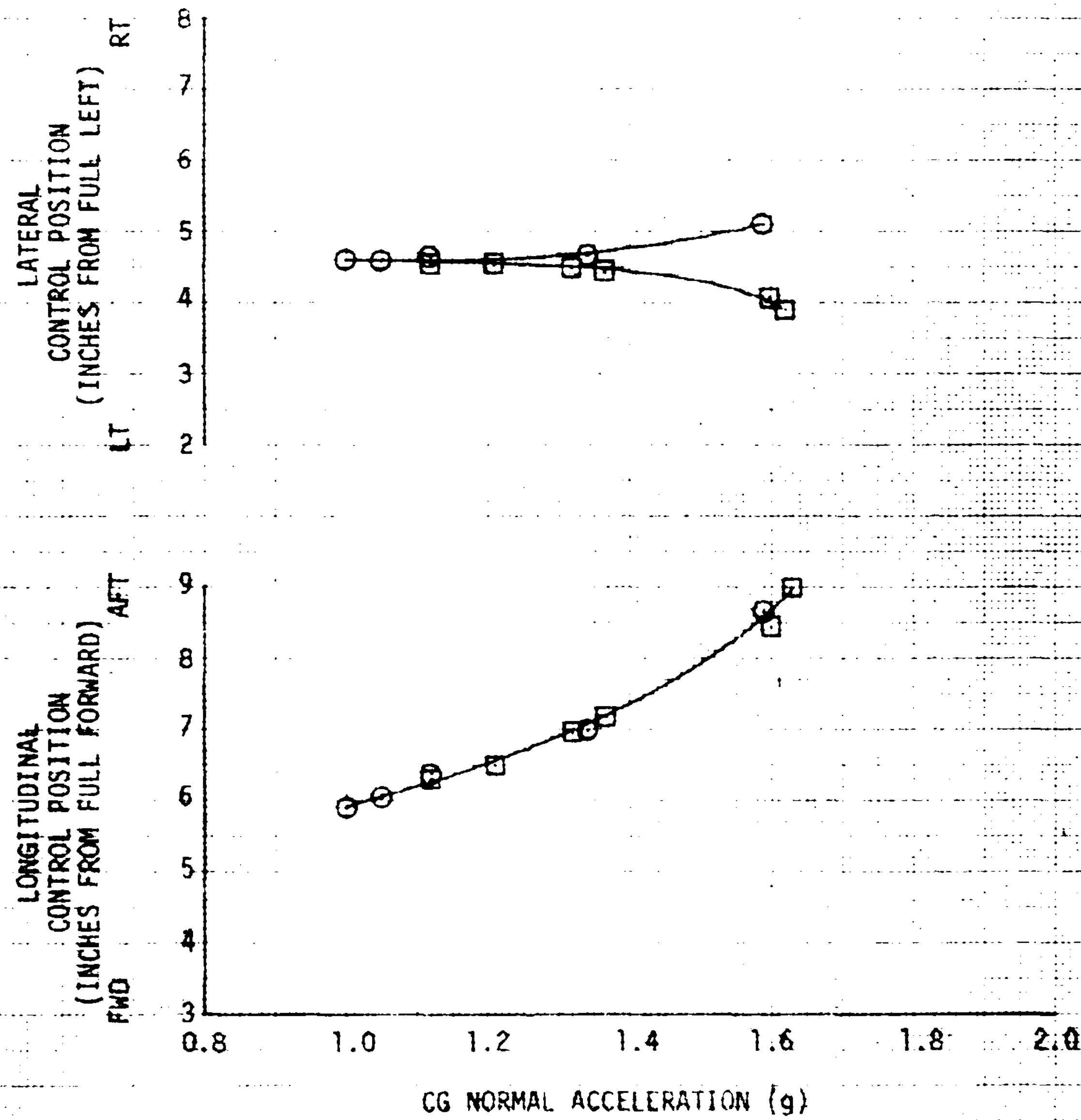


FIGURE 34
MANEUVERING STABILITY
JOH-6A LCH (AH-6C) USA S/N 69-16054

SYM	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	AVG CALIBRATED AIRSPEED (KTS)	FLIGHT CONDITION
○	2610	100.0(FWD)	0.5 RT	7320	22.0	484	74	RT TURN
□	2570	100.0(FWD)	0.5 RT	7640	21.0	485	76	LT TURN

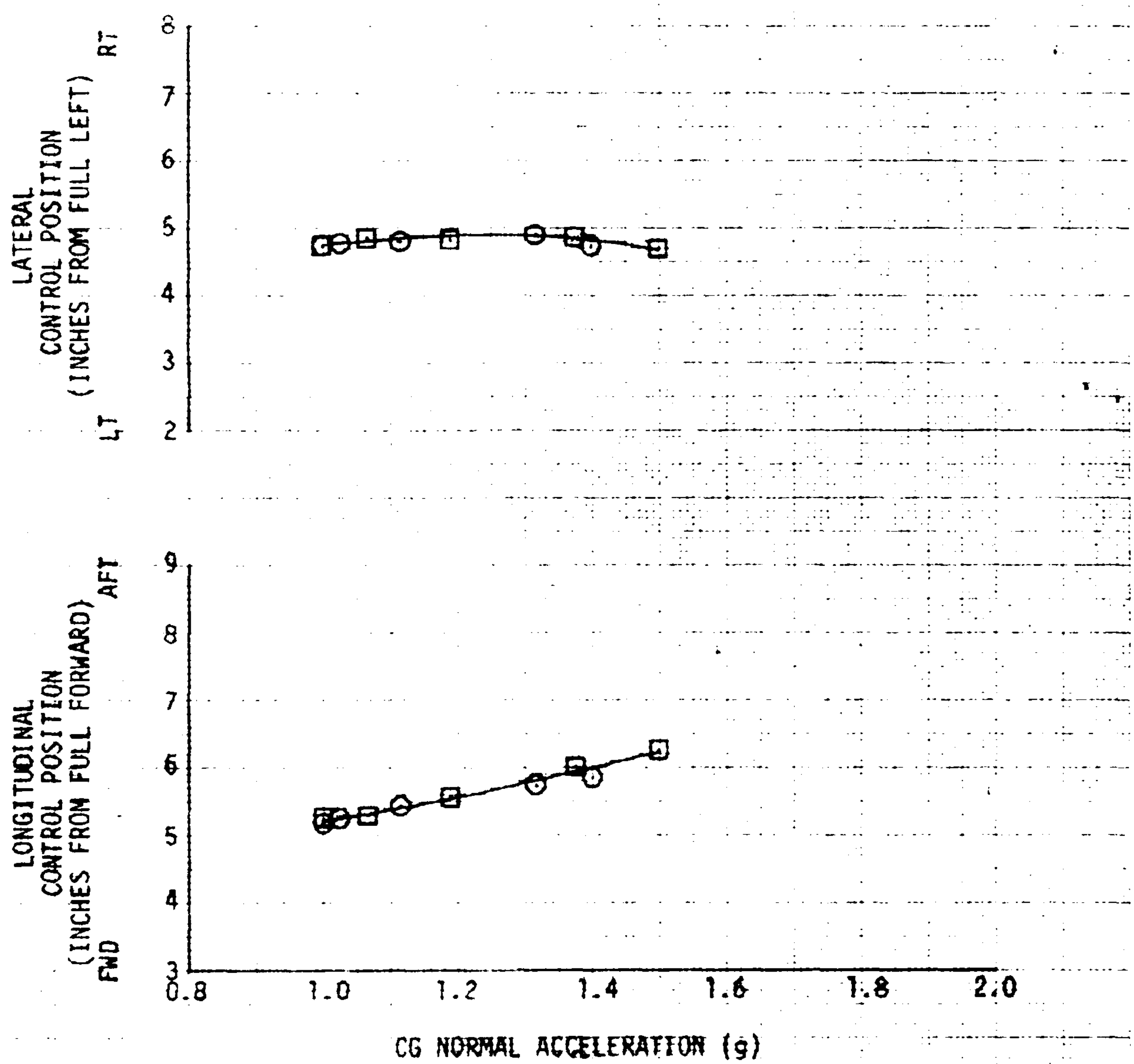


FIGURE 35
MANEUVERING STABILITY
SYMMETRICAL PUSHOVERS AND PULLUPS
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	AVG CALIBRATED AIRSPEED (KTS)
2600	100.3(FWD)	0.5 RT	7110	26.5	483	59

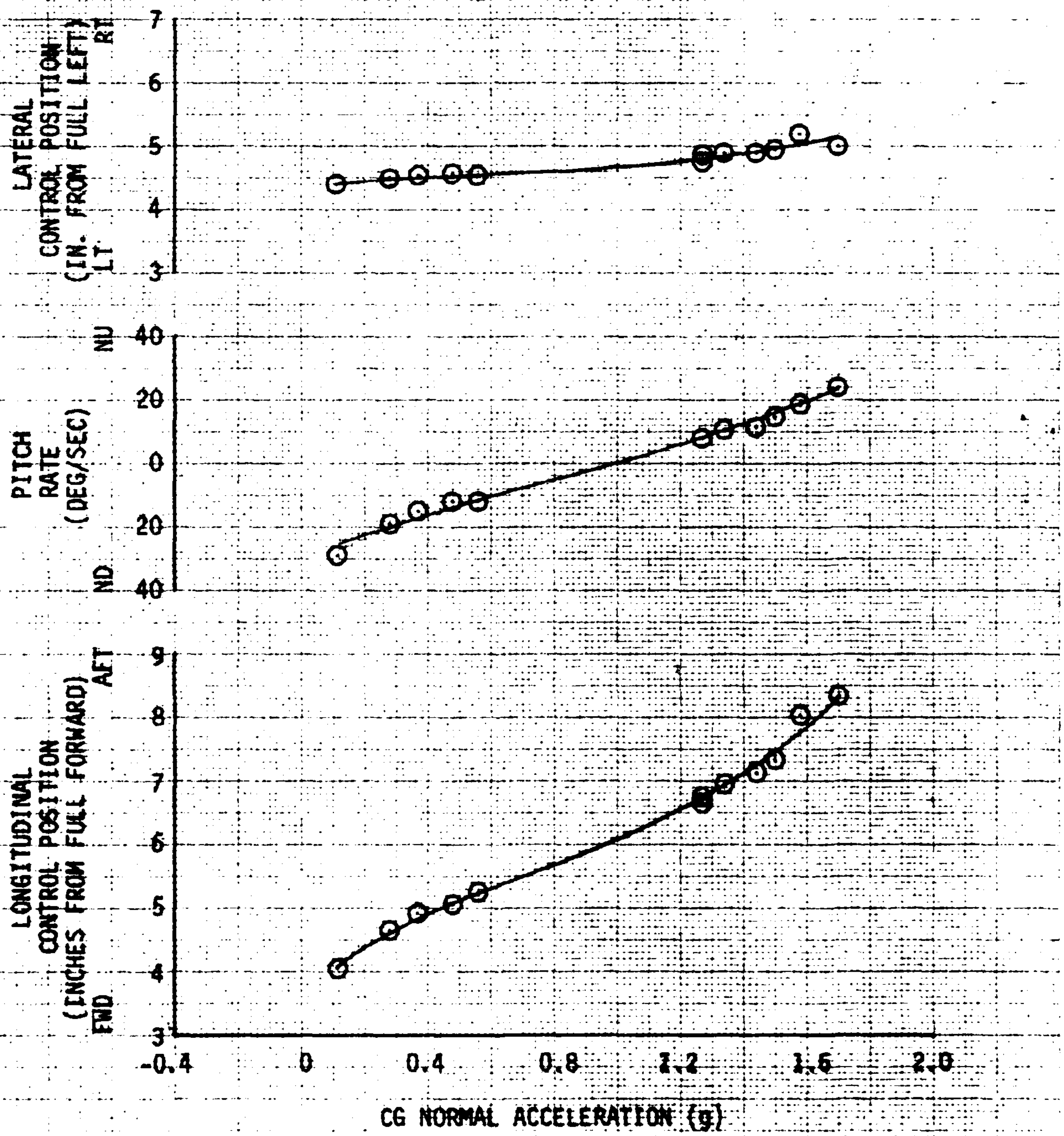


FIGURE 36
MANEUVERING STABILITY
SYMMETRICAL PUSHOVERS AND PULLUPS
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	AVG CALIBRATED AIRSPEED (KTS)
2570	100.3(FWD)	0.5 RT	7070	27.0	484	75

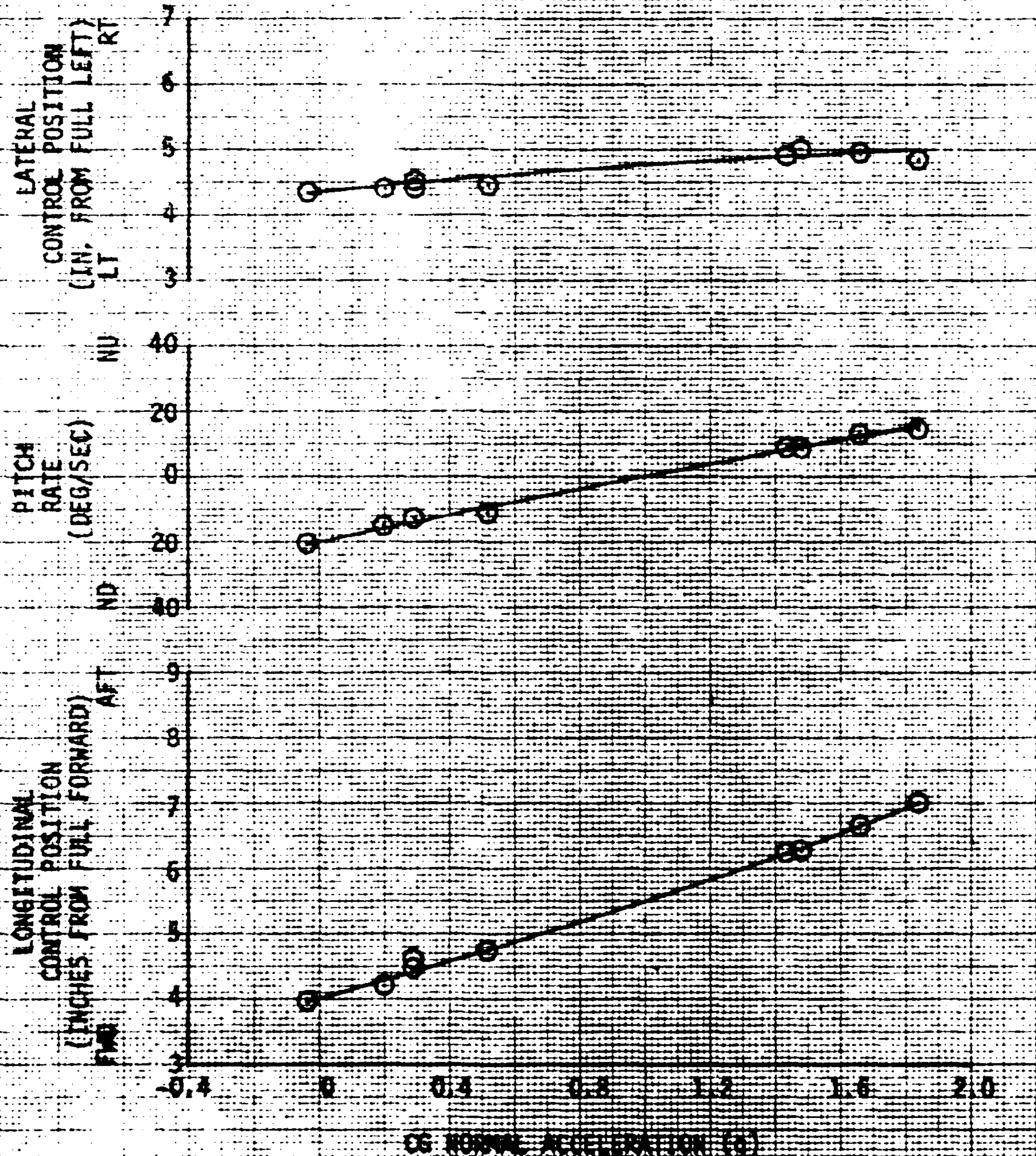


FIGURE 37
MANEUVERING STABILITY
JOH-6A LCH (AH-6C) USA S/N 69-16054

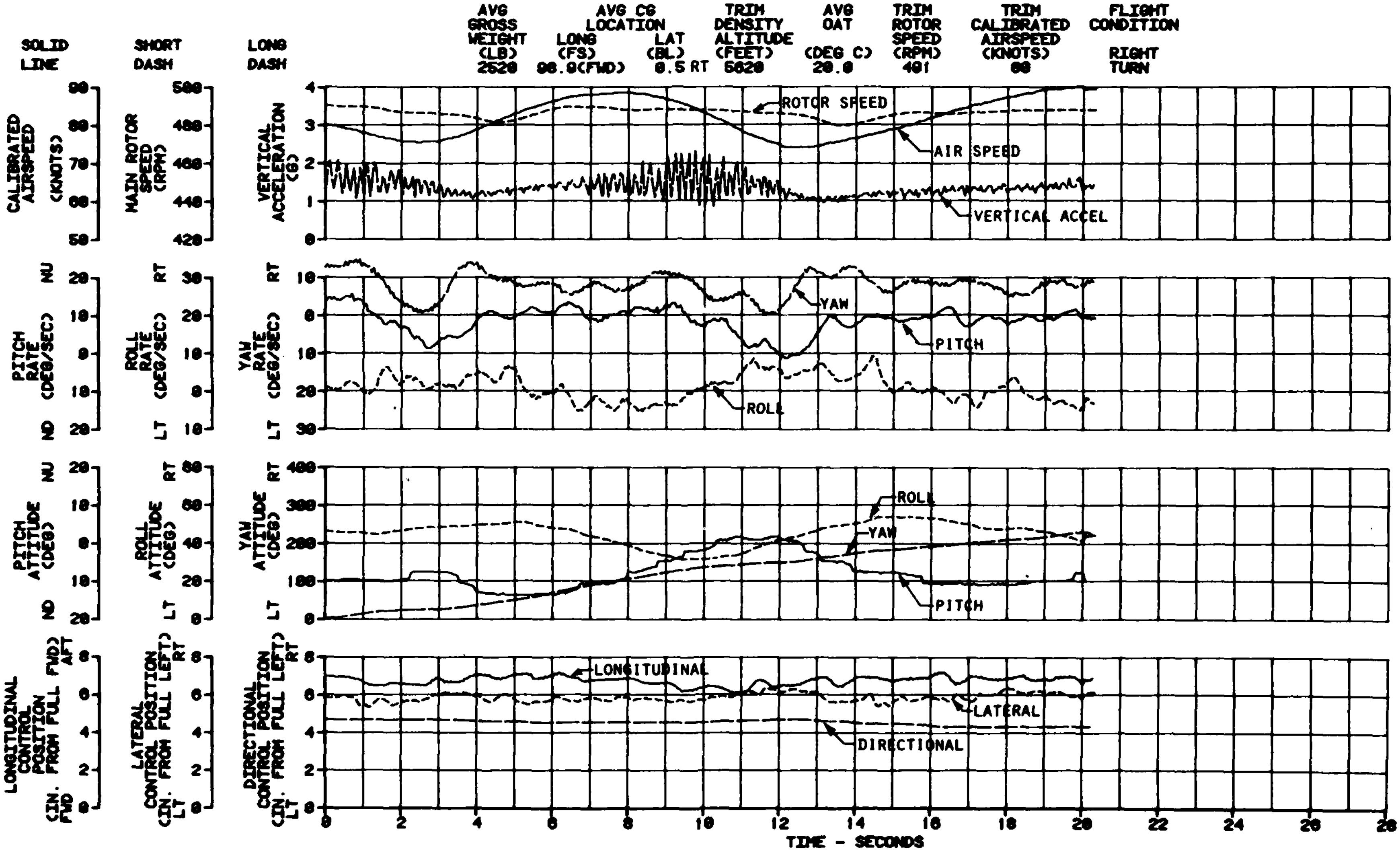


FIGURE 38
PEDAL DOUBLET
JOH-6A LCH (AH-6C) USA S/N 69-16064

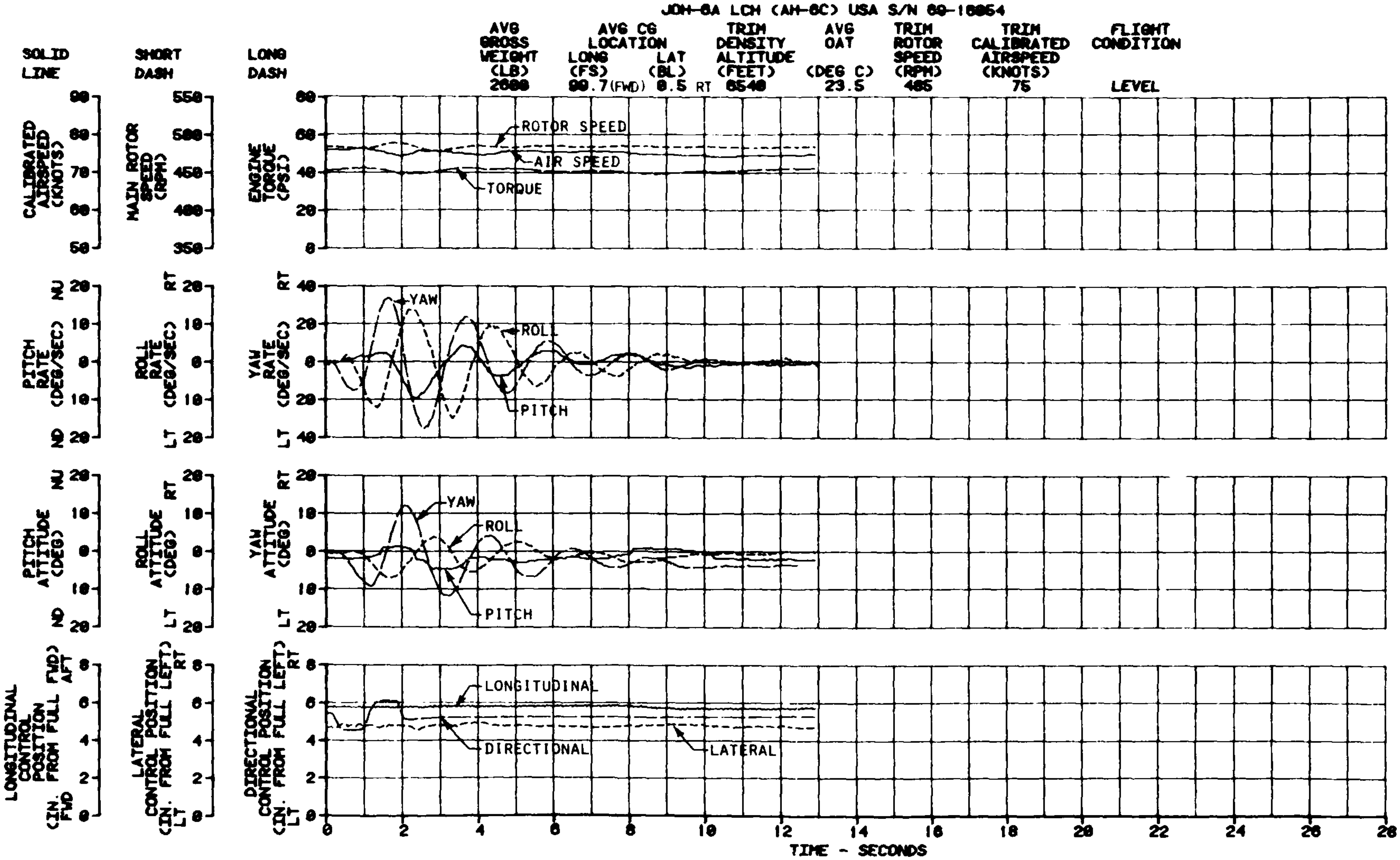


FIGURE 39

PEDAL DOUBLET

JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	TRIM DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	TRIM ROTOR SPEED (RPM)	TRIM CALIBRATED AIRSPEED (KNOTS)	FLIGHT CONDITION
2690	99.6(FWD)	0.5 RT	8780	19.5	483	61	CLIMB

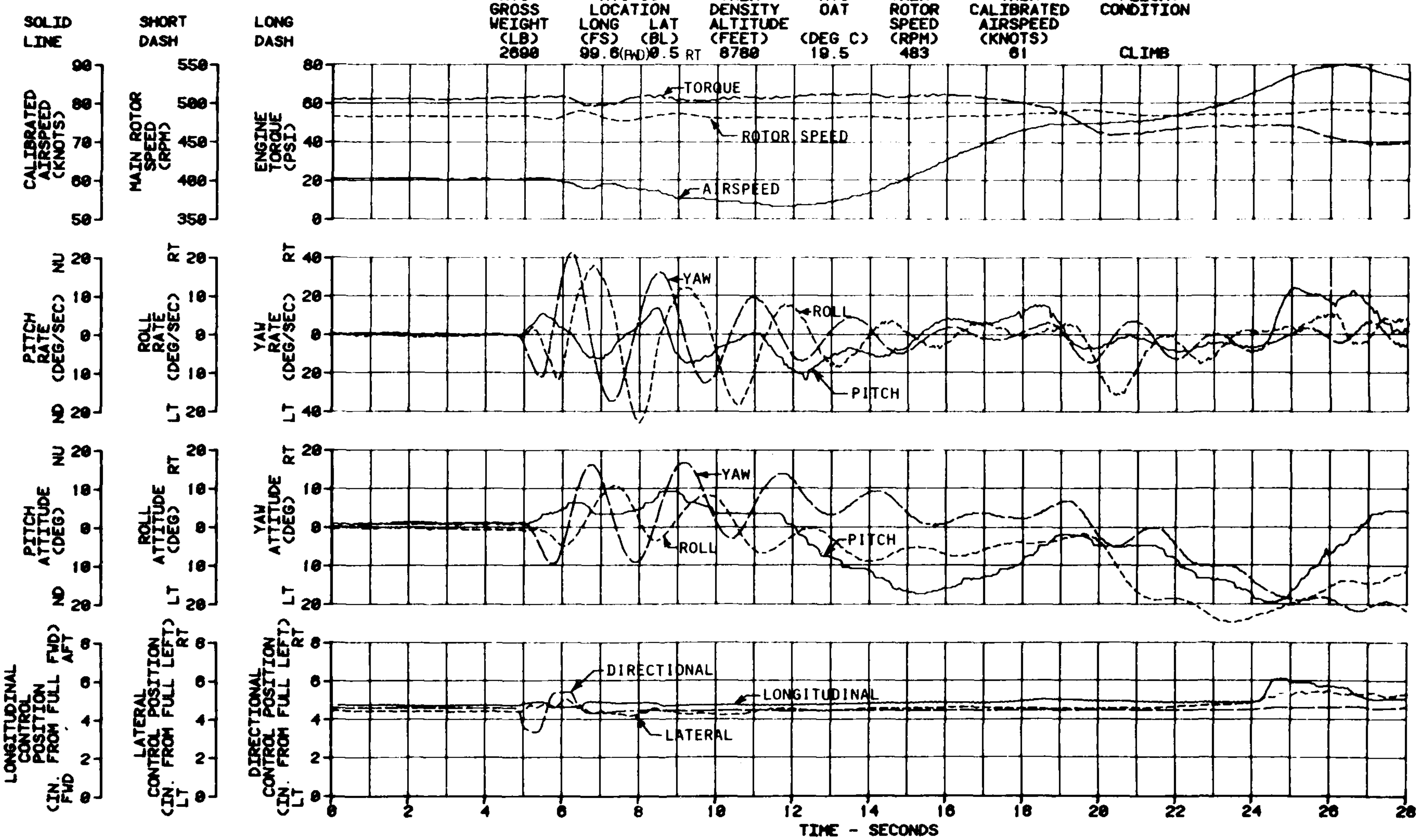


FIGURE 40
LONG TERM RESPONSE
JOH-6A LCH (AH-6C) USA S/N 69-16054

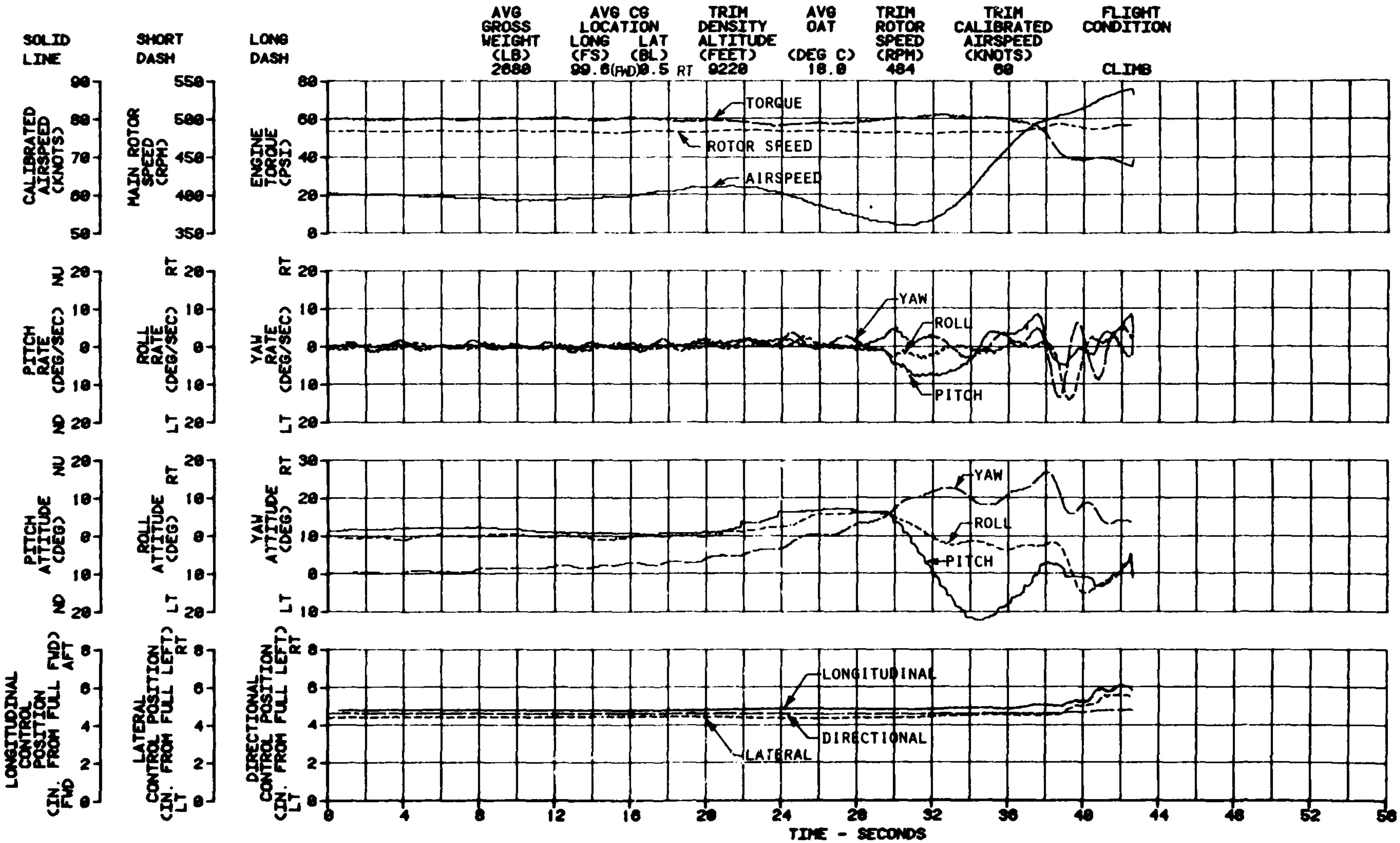


FIGURE 41
LONGITUDINAL CONTROL RESPONSE AND SENSITIVITY
JOH-6A LCH (AH-6C) USA S/N 69-16054

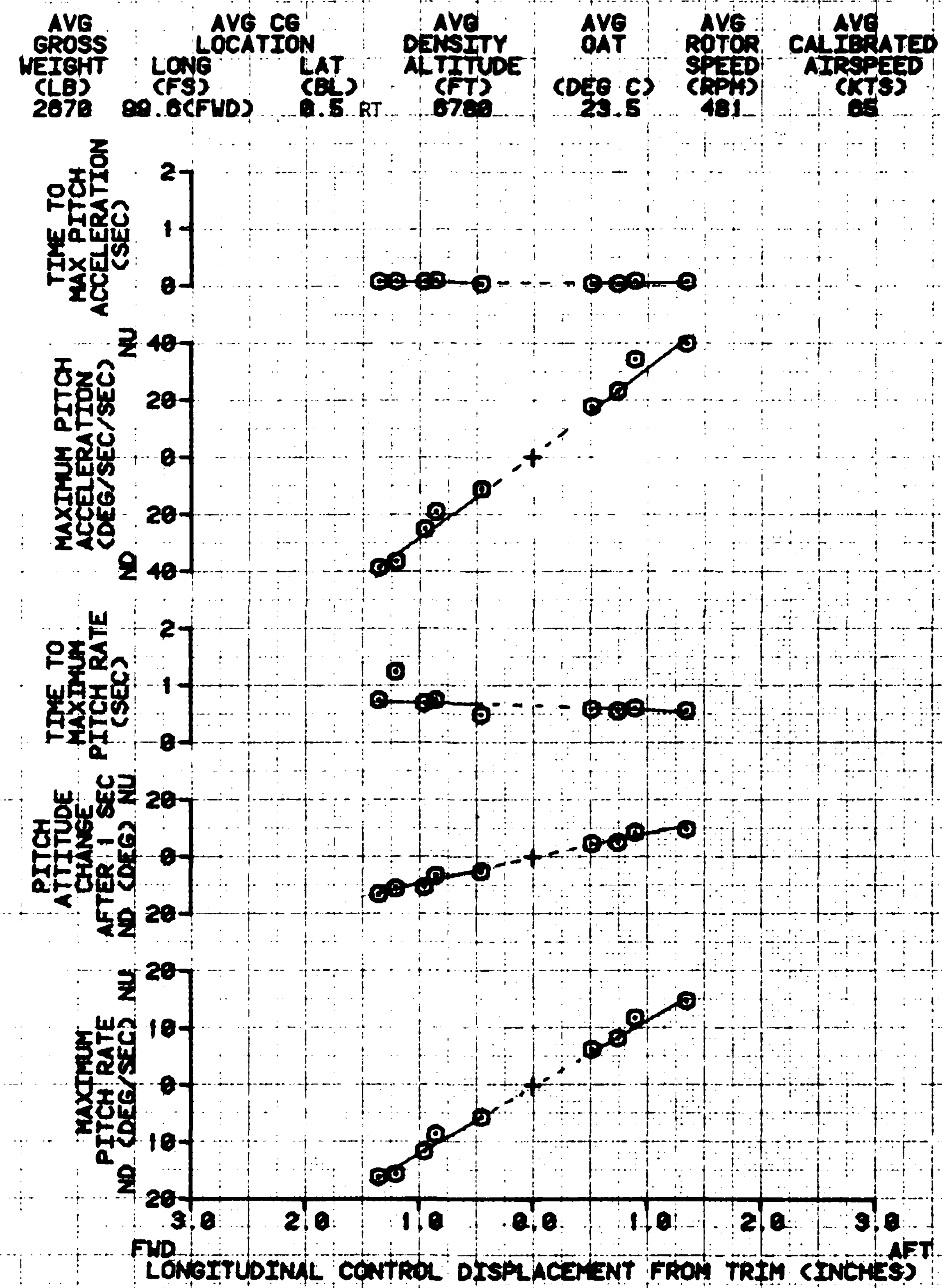
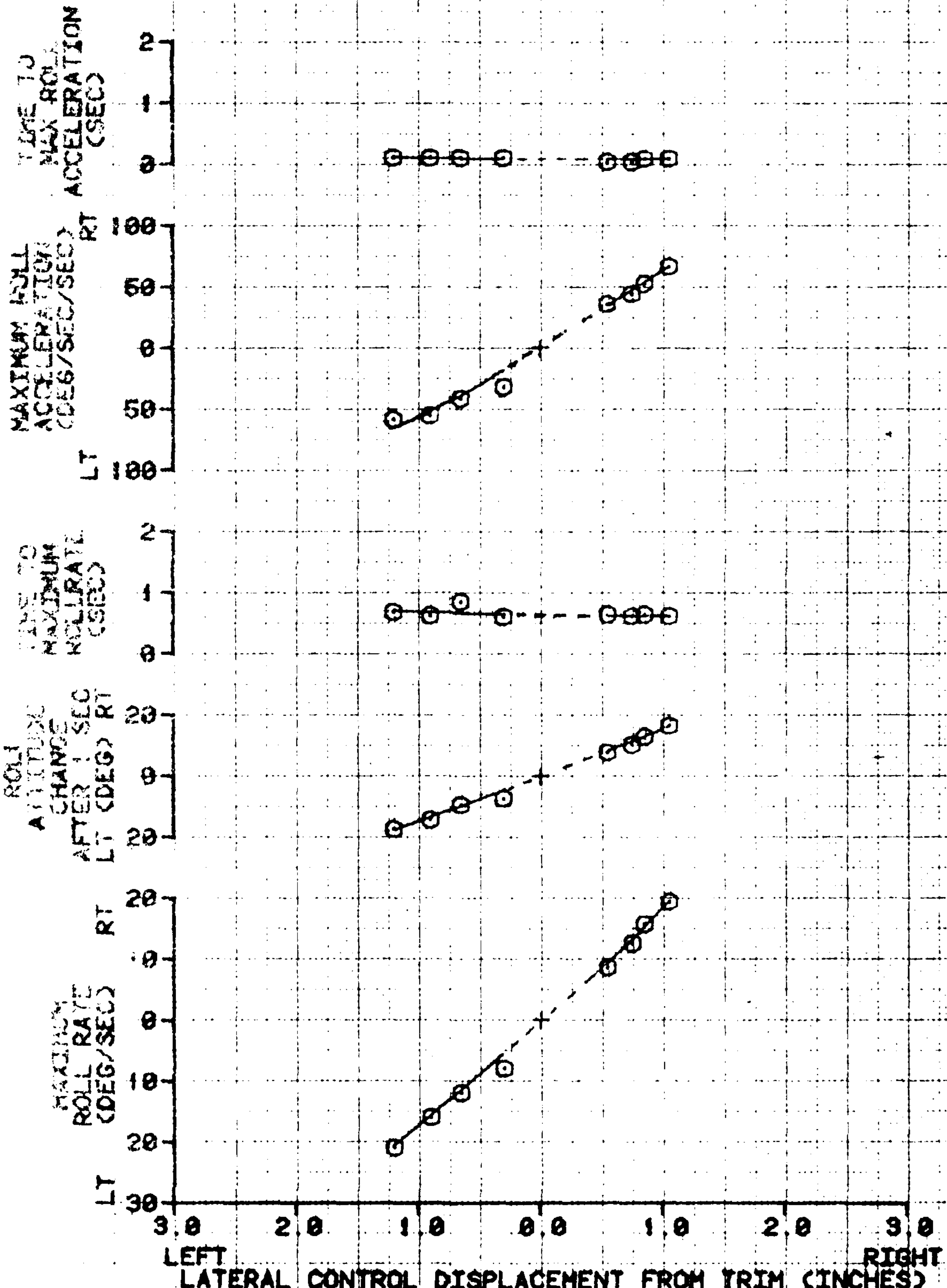


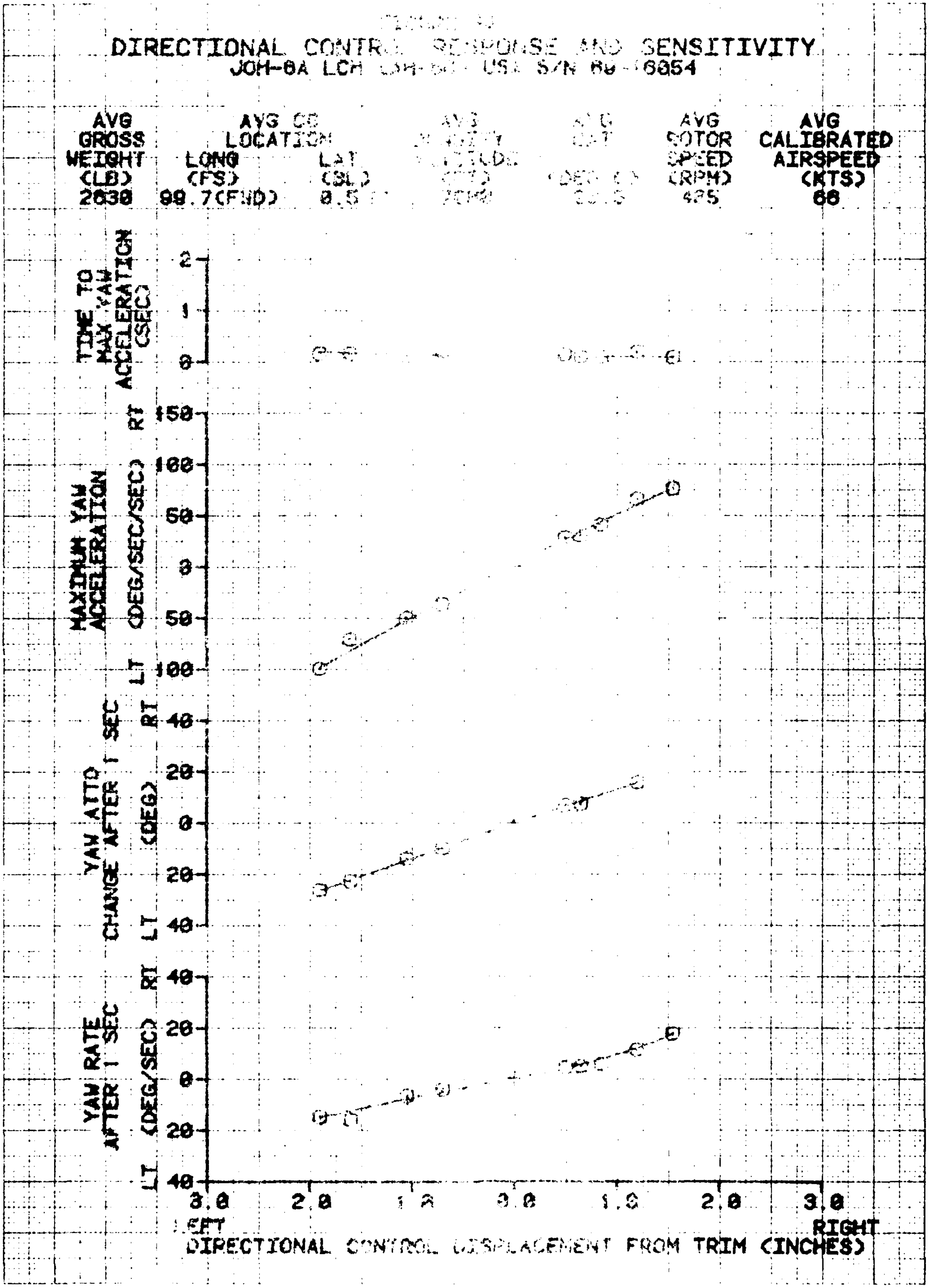
FIGURE 42

LATERAL CONTROL RESPONSE AND SENSITIVITY

JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG CALIBRATED AIRSPEED (KTS)
2650	09.7(FWD)	0.5 RT	7000	23.5	484	69





DIRECTIONAL CONTR SENSITIVITY
AVG GROSS WEIGHT (LB) 2630
AVG CG LOCATION LONG (FS) 99.7(FWD) LAT (BL) 0.5
AVG ROTOR SPEED (RPM) 425
AVG CALIBRATED AIRSPEED (KTS) 60
TIME TO MAX YAW ACCELERATION (SEC)
MAXIMUM YAW ACCELERATION (DEG/SEC/SEC)
YAW ATTD CHANGE AFTER 1 SEC (DEG)
YAW RATE AFTER 1 SEC (DEG/SEC)
RT
LT
LEFT
RIGHT
DIRECTIONAL CONTROL DISPLACEMENT FROM TRIM (INCHES)

FIGURE 44

DIRECTIONAL CONTROL RESPONSE AND SENSITIVITY

JOH-6A LOH (AH-6C) USA S/N 60-13054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
2450	99.1 (FWD)	0.5	1240	20.5	482	HOVER

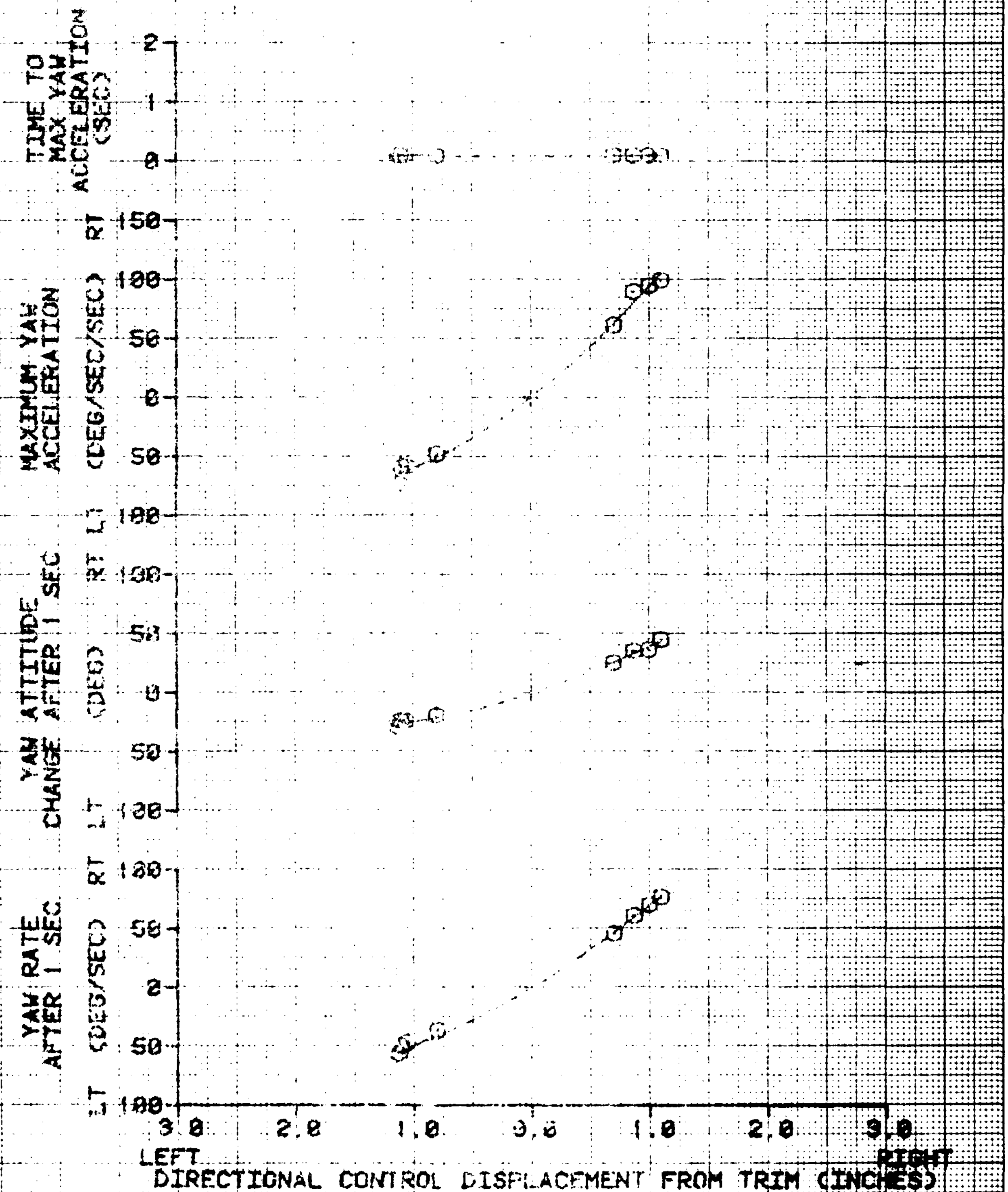


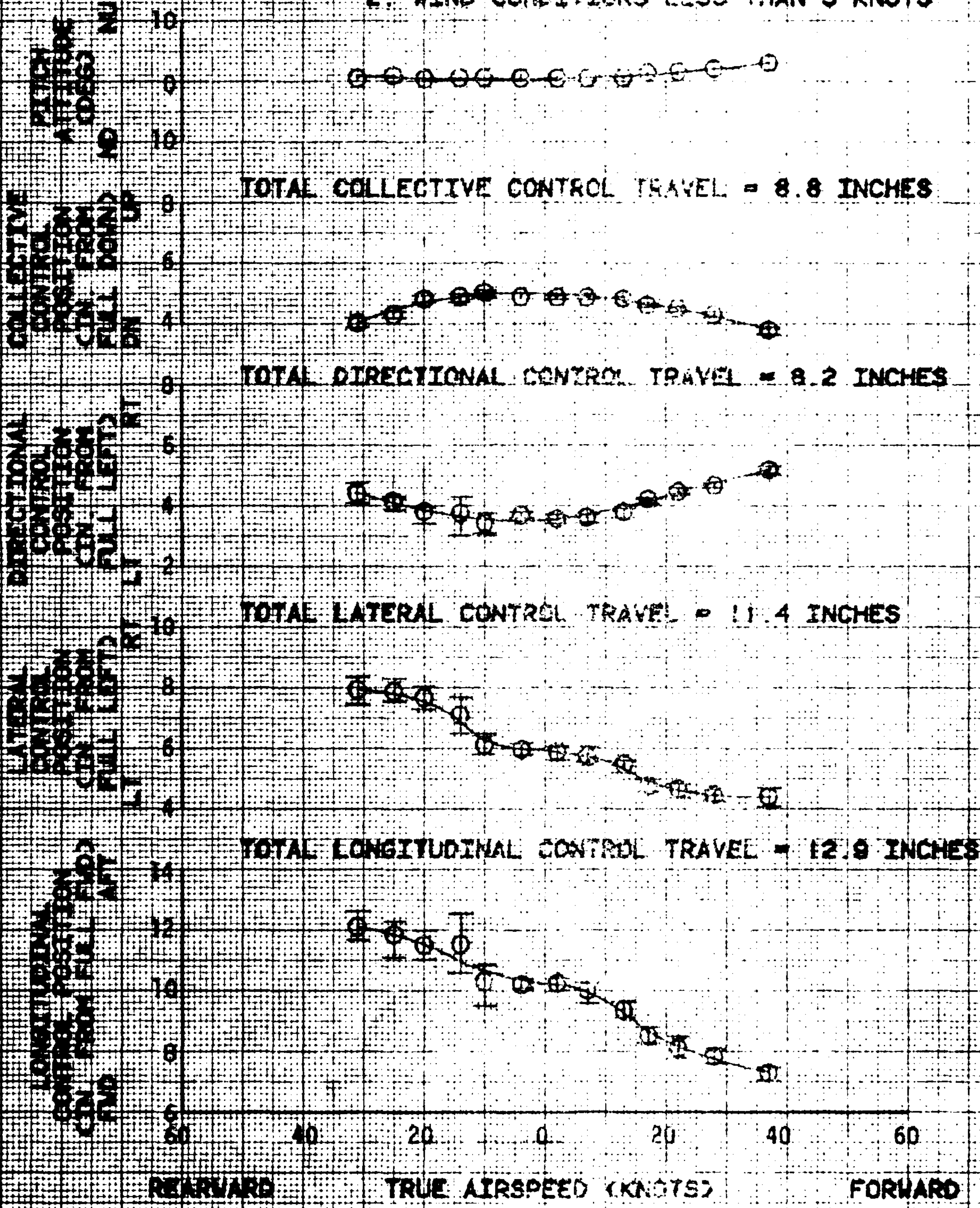
FIGURE 4[illegible]

LOW SPEED FORWARD AND REARWARD FLIGHT

JOH-6A LCH (AH-6C) USA S/N 68-15054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	SKID HEIGHT (FT)
2680	99.1(FWD)	0.5 RT	7280	21.0	483	5

NOTES: 1. I DENOTES EXTREME TRAVEL FROM TRIM DURING ATTEMPTED STABILIZED POINT
2. WIND CONDITIONS LESS THAN 5 KNOTS



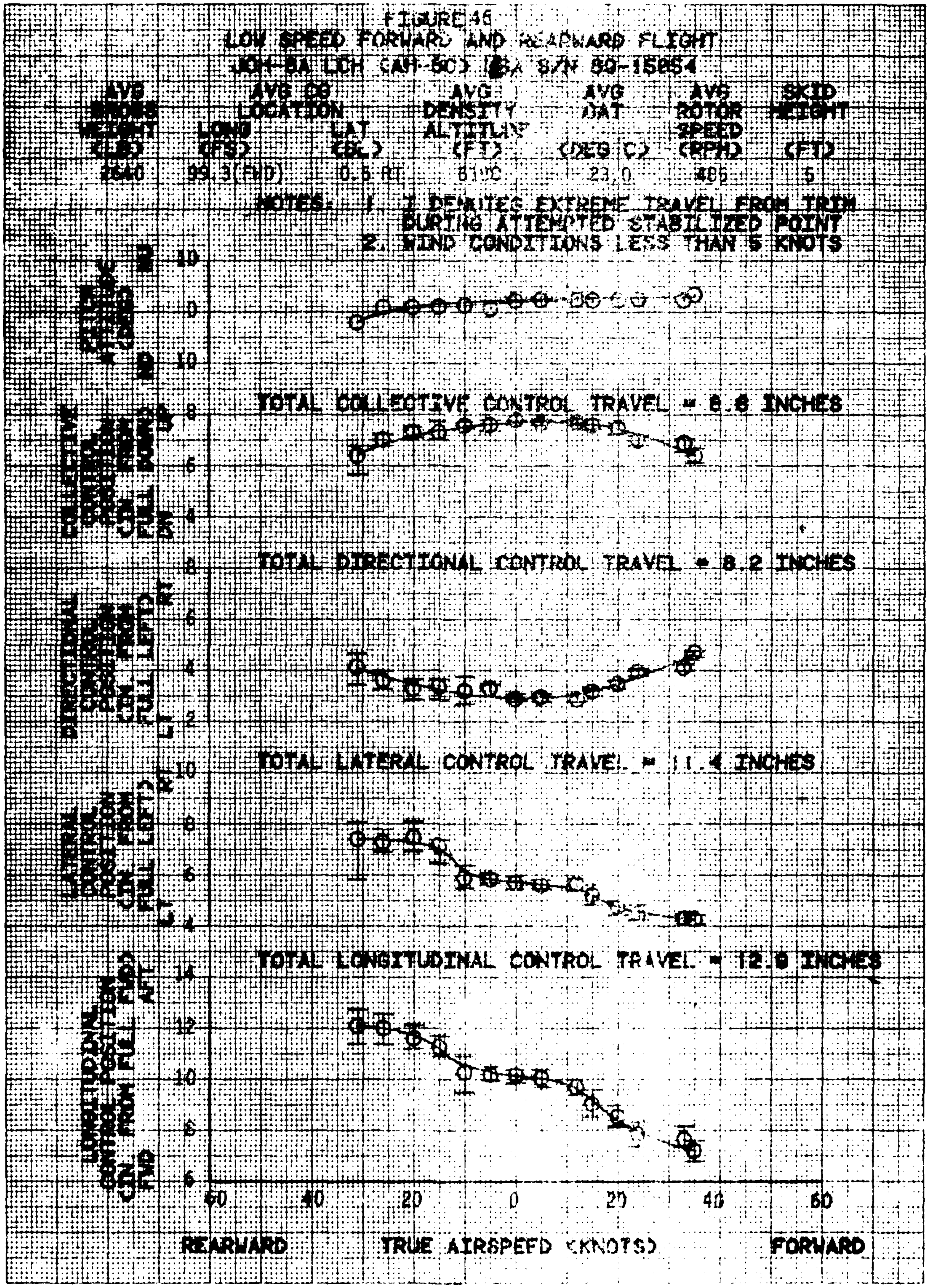


FIGURE 45
LOW SPEED FORWARD AND REARWARD FLIGHT
JOH-6A LCH (AH-6C) USA S/N 69-15054
AVG GROSS WEIGHT (LB) 2640
AVG CG LOCATION LONG (FS) 99.3 (FWD)
LAT (BL) 0.5 RT
AVG DENSITY ALTITUDE (FT)
AVG OAT (DEG C) 23.0
AVG ROTOR SPEED (RPM) 485
SKID HEIGHT (FT) 5
NOTES: 1. I DENOTES EXTREME TRAVEL FROM TRIM DURING ATTEMPTED STABILIZED POINT
2. WIND CONDITIONS LESS THAN 5 KNOTS
TOTAL COLLECTIVE CONTROL TRAVEL = 8.8 INCHES
TOTAL DIRECTIONAL CONTROL TRAVEL = 8.2 INCHES
TOTAL LATERAL CONTROL TRAVEL = 11.4 INCHES
TOTAL LONGITUDINAL CONTROL TRAVEL = 12.8 INCHES
DIRECTIONAL CONTROL POSITION FROM FULL LEFT (IN)
LATERAL CONTROL POSITION FROM FULL LEFT (IN)
LONGITUDINAL CONTROL POSITION FROM FULL FWD (IN)
REARWARD
TRUE AIRSPEED (KNOTS)
FORWARD

FIGURE 47

LOW SPEED FORWARD AND REARWARD FLIGHT

JOH-6A LCH (AH-6C) USA S/N 69-15054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	SKID HEIGHT (FT)
2680	99.2(FWD)	0.2(RT)	[illegible]	[illegible]	483	5

NOTES: 1. I DENOTES EXTREME TRAVEL FROM TRIM DURING ATTEMPTED STABILIZED POINT
2. WIND CONDITIONS LESS THAN 5 KNOTS

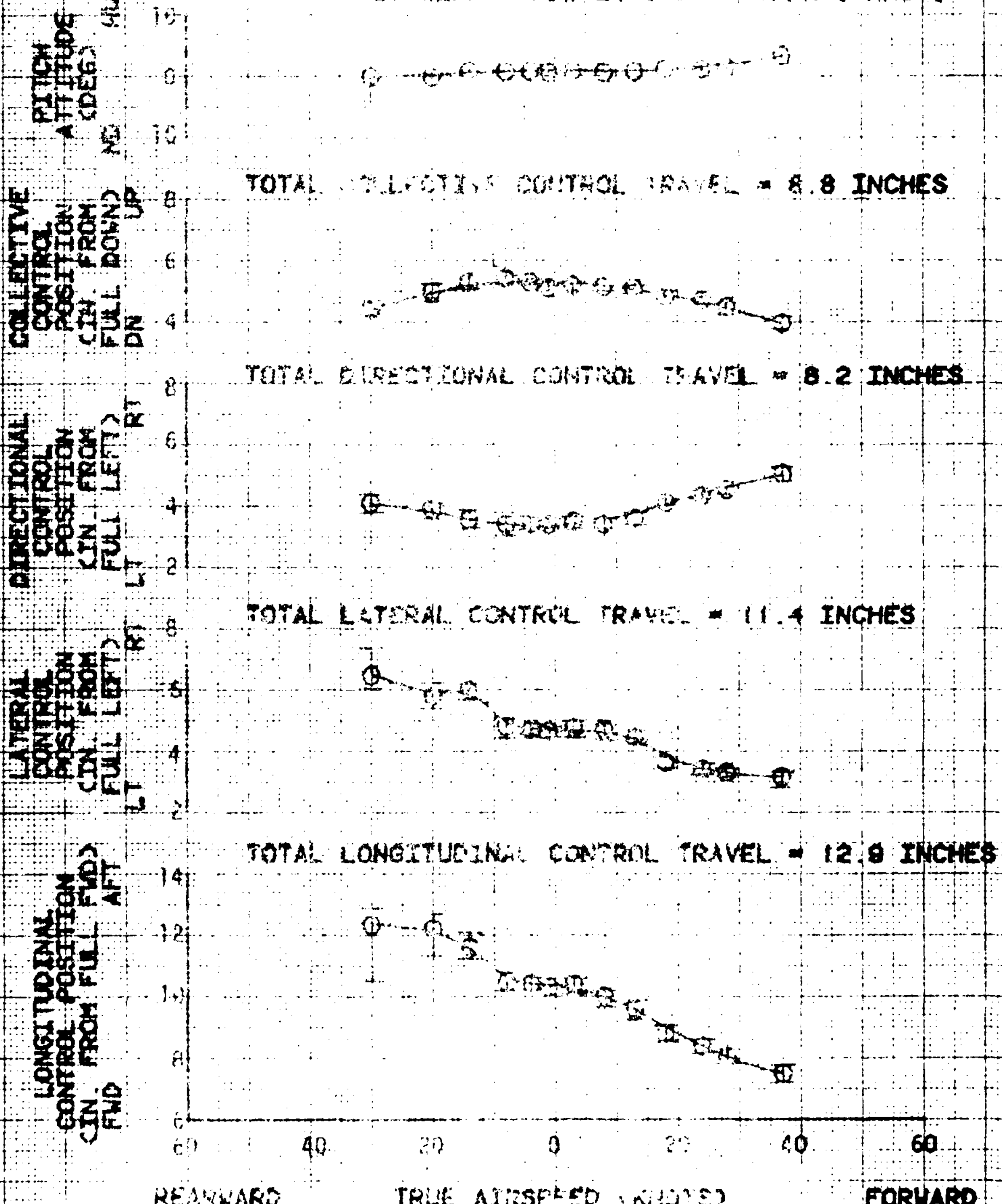


FIGURE 48
LOW SPEED FORWARD AND REARWARD FLIGHT
JOH-6A LOH (AH-6C) USA S/N 69-18054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	SKID HEIGHT (FT)
2660	99.2(FWD)	2.2(RT)	5510	20.0	483	5

NOTES: 1. I DENOTES EXTREME TRAVEL FROM TRIM DURING ATTEMPTED STABILIZED POINT
2. WIND CONDITIONS LESS THAN 5 KNOTS

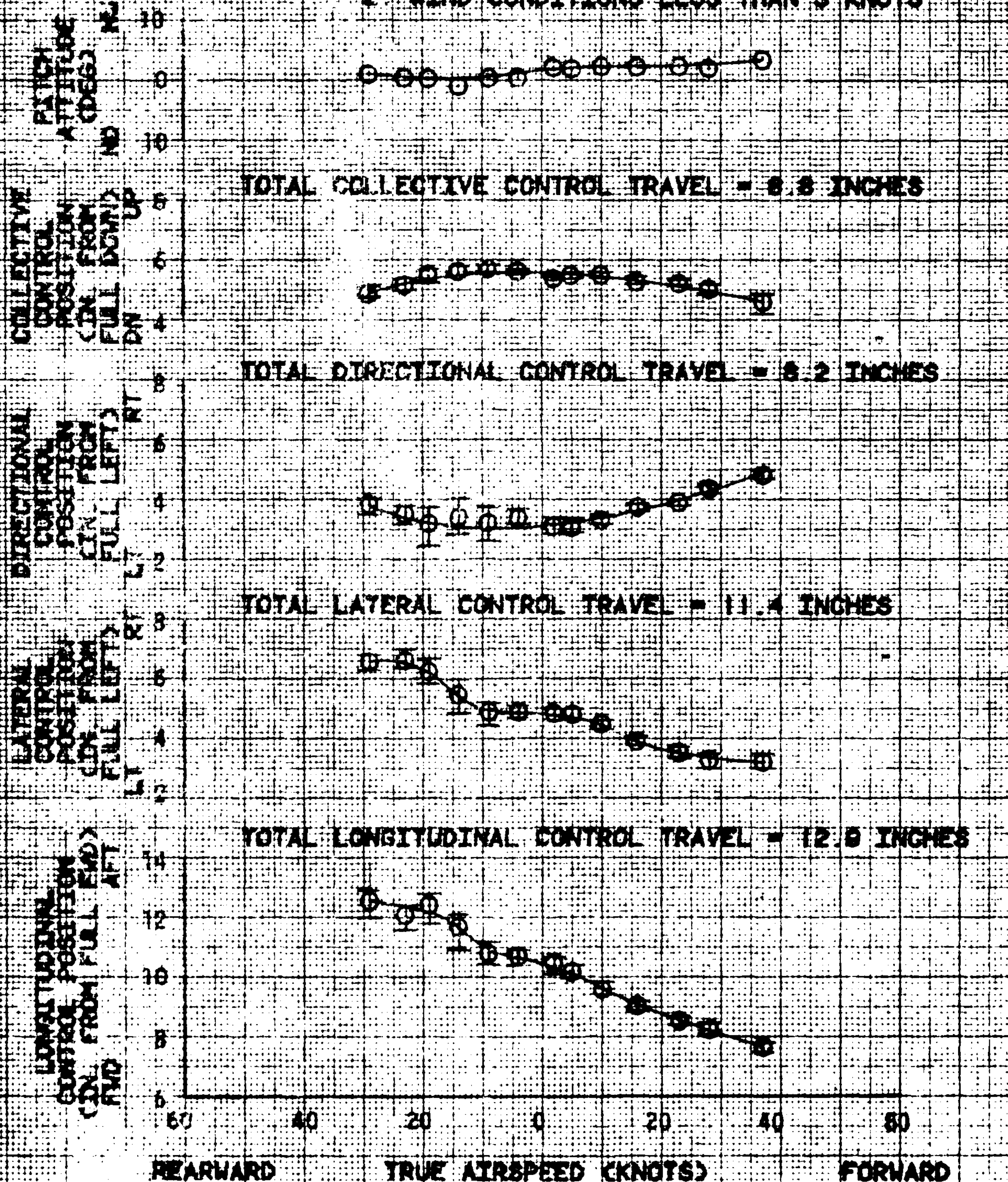


FIGURE 49
SIDEWARD FLIGHT
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG SKID HEIGHT (FT)
2620	99.1(FWD)	0.5 RT	1220	20.0	483	5

NOTES: 1. I DENOTES EXTREME TRAVEL FROM TRIM DURING ATTEMPTED STABILIZED POINT
2. WIND CONDITIONS LESS THAN 5 KNOTS

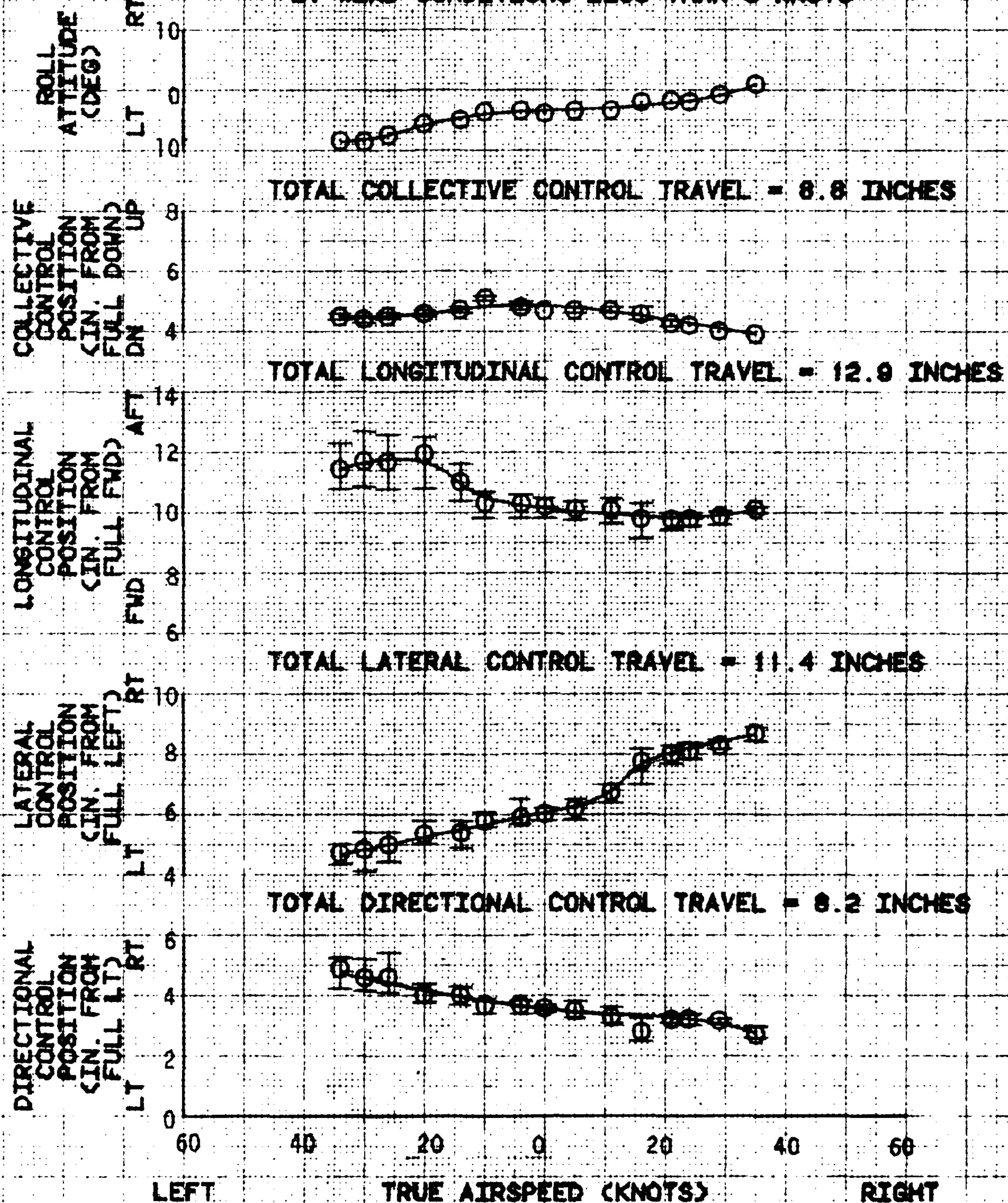


FIGURE 50
SIDEWARD FLIGHT
JOH-6A LCH (AH-6C) USA S/N 68-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (B.L)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG SKID HEIGHT (FT)
2650	99.3(FWD)	0.5 RT	6180	23.0	483	5

NOTES: 1. I DENOTES EXTREME TRAVEL FROM TRIM DURING ATTEMPTED STABILIZED POINT
2. WIND CONDITIONS LESS THAN 5 KNOTS

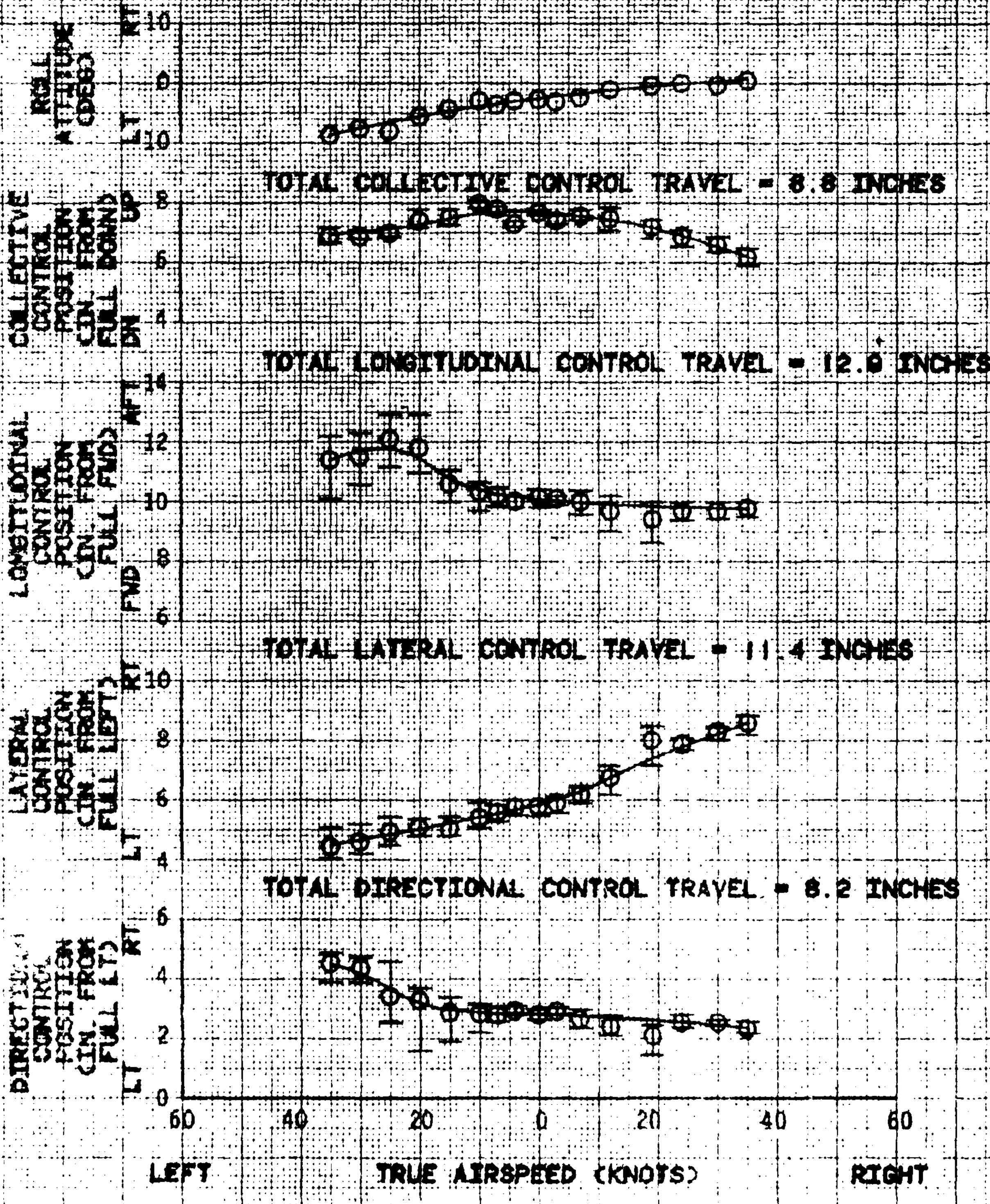


FIGURE 51
SIDEWARD FLIGHT
JOH-6A LCH (AH-6C) USA S/N 69-16064

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG SKID HEIGHT (FT)
2660	99.2(FWD)	2.2(RT)	1650	24.0	483	5

NOTES: 1. I DENOTES EXTREME TRAVEL FROM TRIM DURING ATTEMPTED STABILIZED POINT
2. WIND CONDITIONS LESS THAN 5 KNOTS

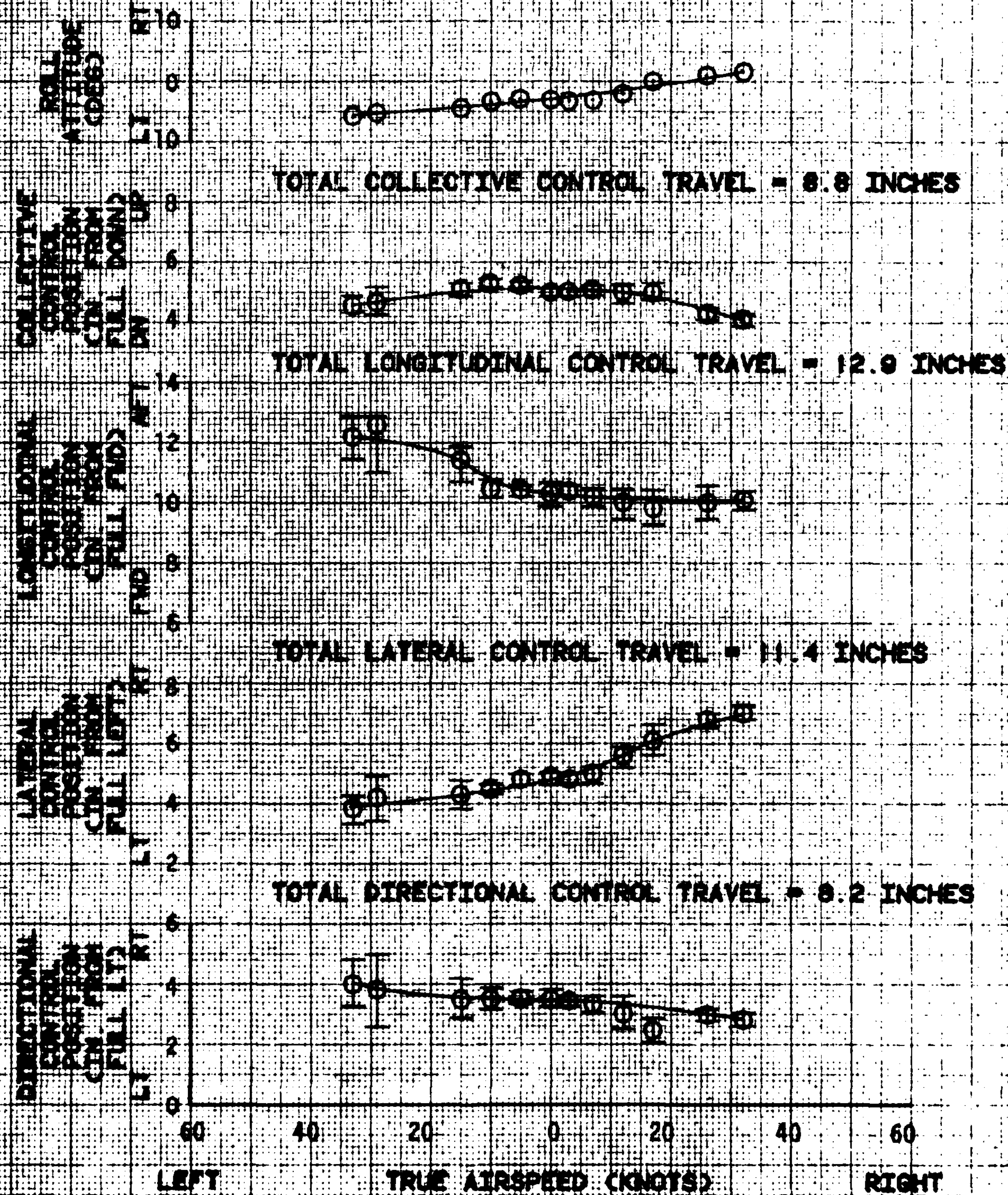


FIGURE 62
SIDEWARD FLIGHT
JOH-6A LOH (AH-6C) USA S/N 69-16254

	AVG CG LOCATION	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG SKID HEIGHT (FT)
		5370	18.5	483	5

NOTES: 1. I DENOTES EXTREME TRAVEL FROM TRIM DURING ATTEMPTED STABILIZED POINT
2. WIND CONDITIONS LESS THAN 5 KNOTS

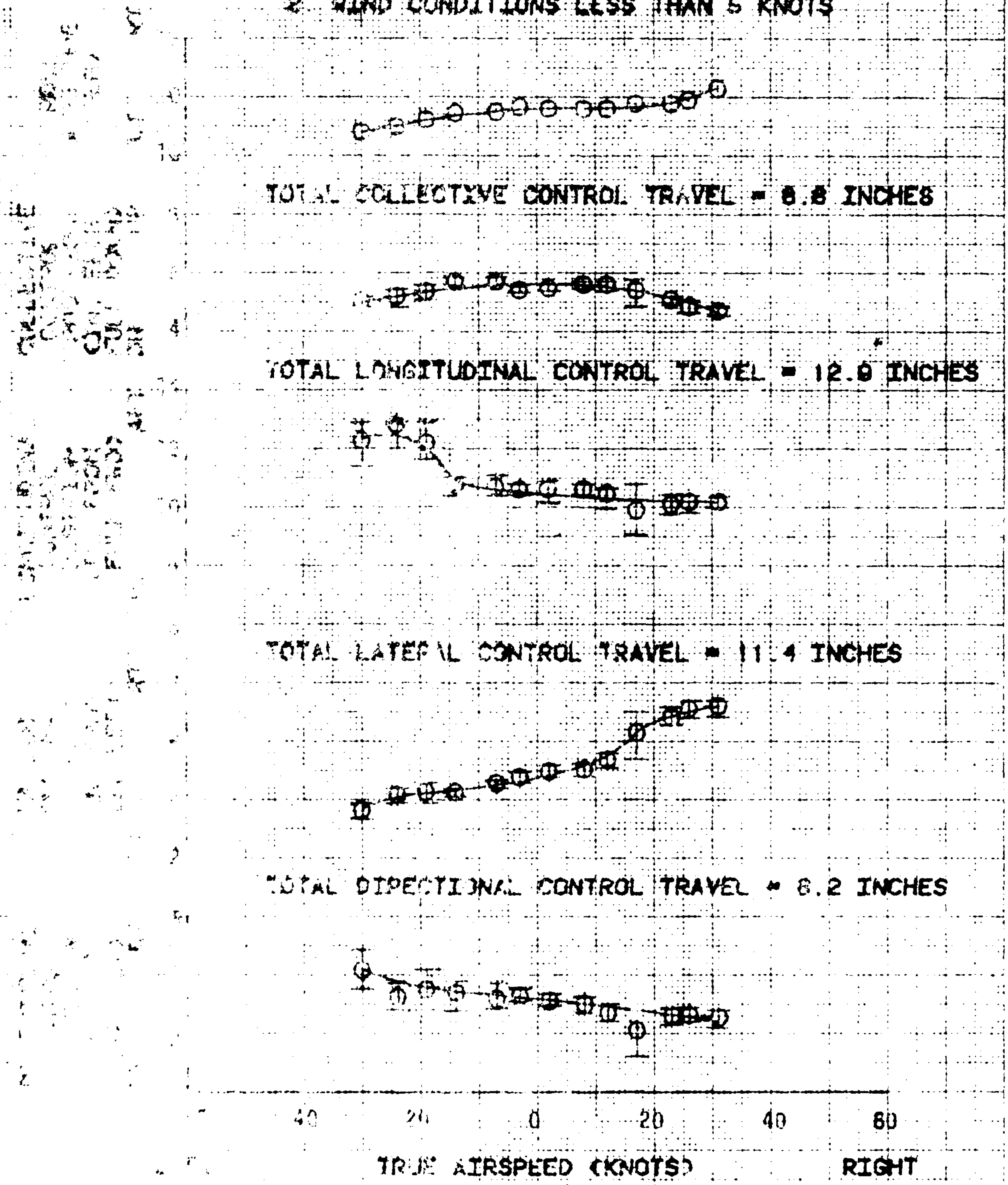


FIGURE 53
LOWSPEED FLIGHT
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG SKID HEIGHT (FT)
2660	99.1(FWD)	0.5RT	1310	21.0	483	5

NOTES: 1. I DENOTES EXTREME TRAVEL FROM TRIM DURING ATTEMPTED STABILIZED POINT
2. WIND CONDITIONS LESS THAN 5 KNOTS
3. RELATIVE WIND AZIMUTH MEASURED CLOCKWISE FROM NOSE OF AIRCRAFT = 045/225 DEG

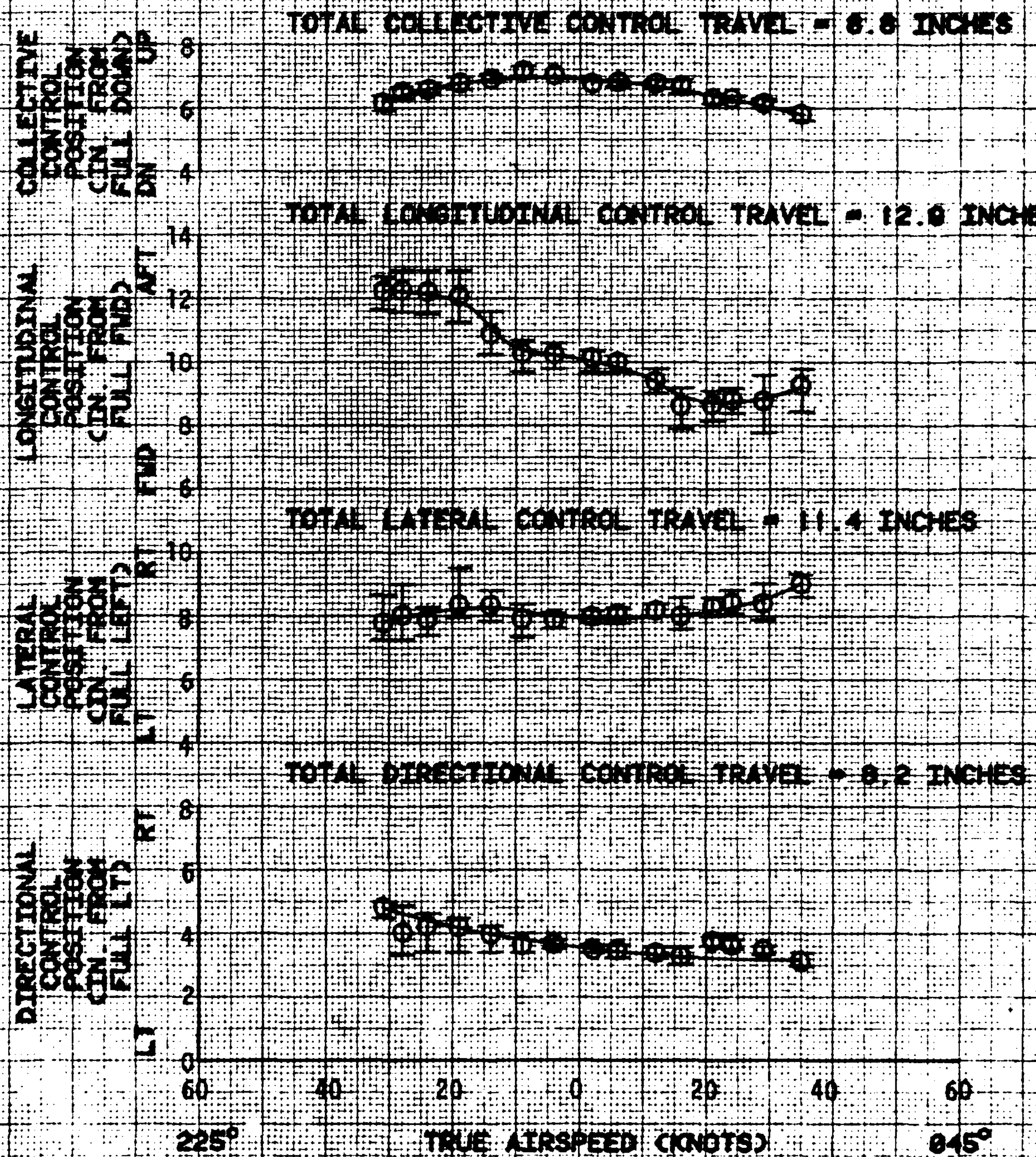


FIGURE 54
LOWSPEED FLIGHT
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG SKID HEIGHT (FT)
2550	99.1(FWD)	0.5 RT	1310	21.0	483	5

NOTES: 1. I DENOTES EXTREME TRAVEL FROM TRIM DURING ATTEMPTED STABILIZED POINT
2. WIND CONDITIONS LESS THAN 5 KNOTS
3. RELATIVE WIND AZIMUTH MEASURED CLOCKWISE FROM NOSE OF AIRCRAFT = 135/315 DEG

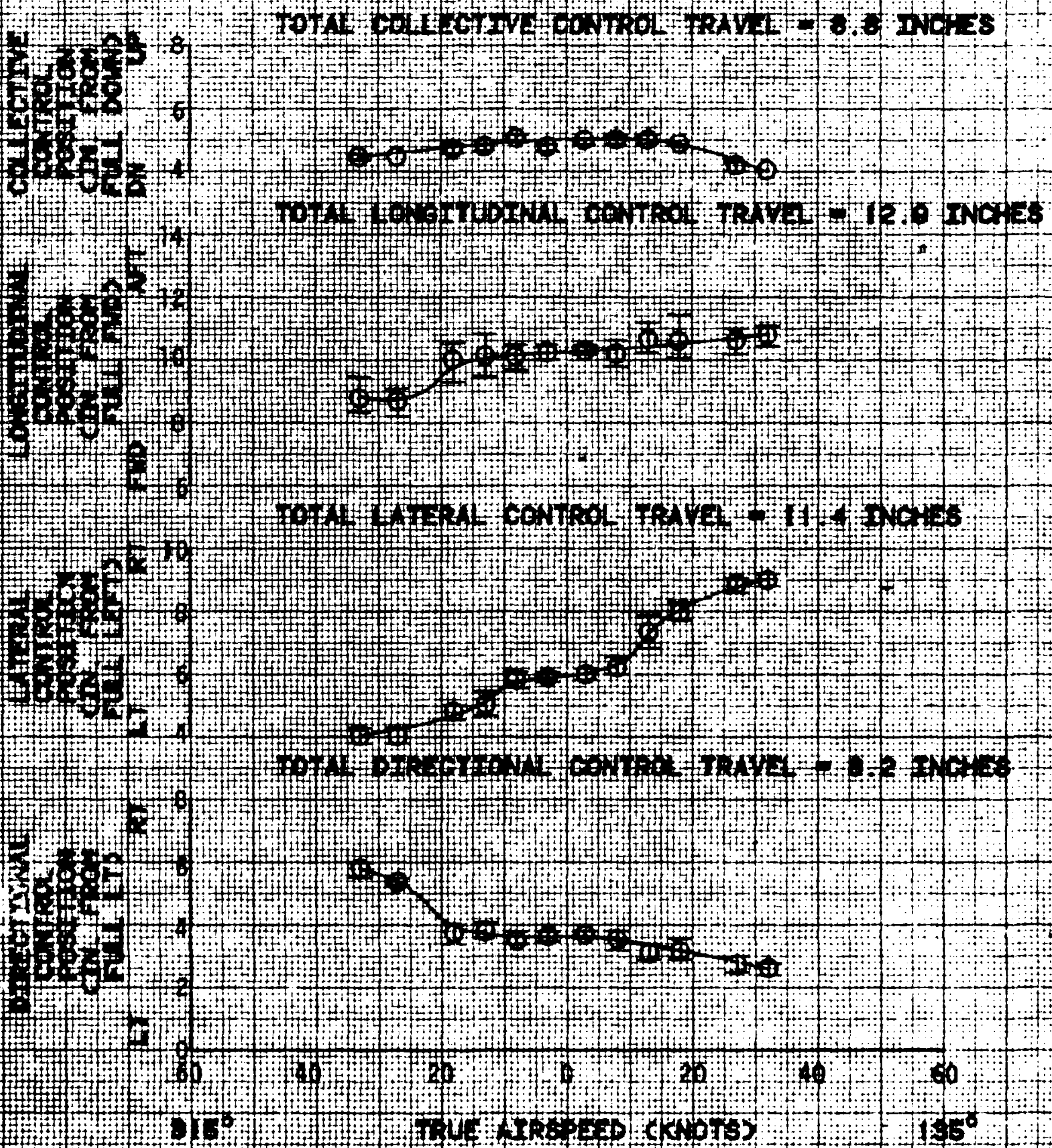


FIGURE 55
LOWSPEED FLIGHT
JOH-6A LCH (AH-6C) USA S/N 69-16354

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG SKID HEIGHT (FT)
2650	99.3(FWD)	0.5 RT	6180	23.0	483	5

NOTES: 1. I DENOTES EXTREME TRAVEL FROM TRIM DURING ATTEMPTED STABILIZED POINT
2. WIND CONDITIONS LESS THAN 5 KNOTS
3. RELATIVE WIND AZIMUTH MEASURED CLOCKWISE FROM NOSE OF AIRCRAFT = 045/225 DEG

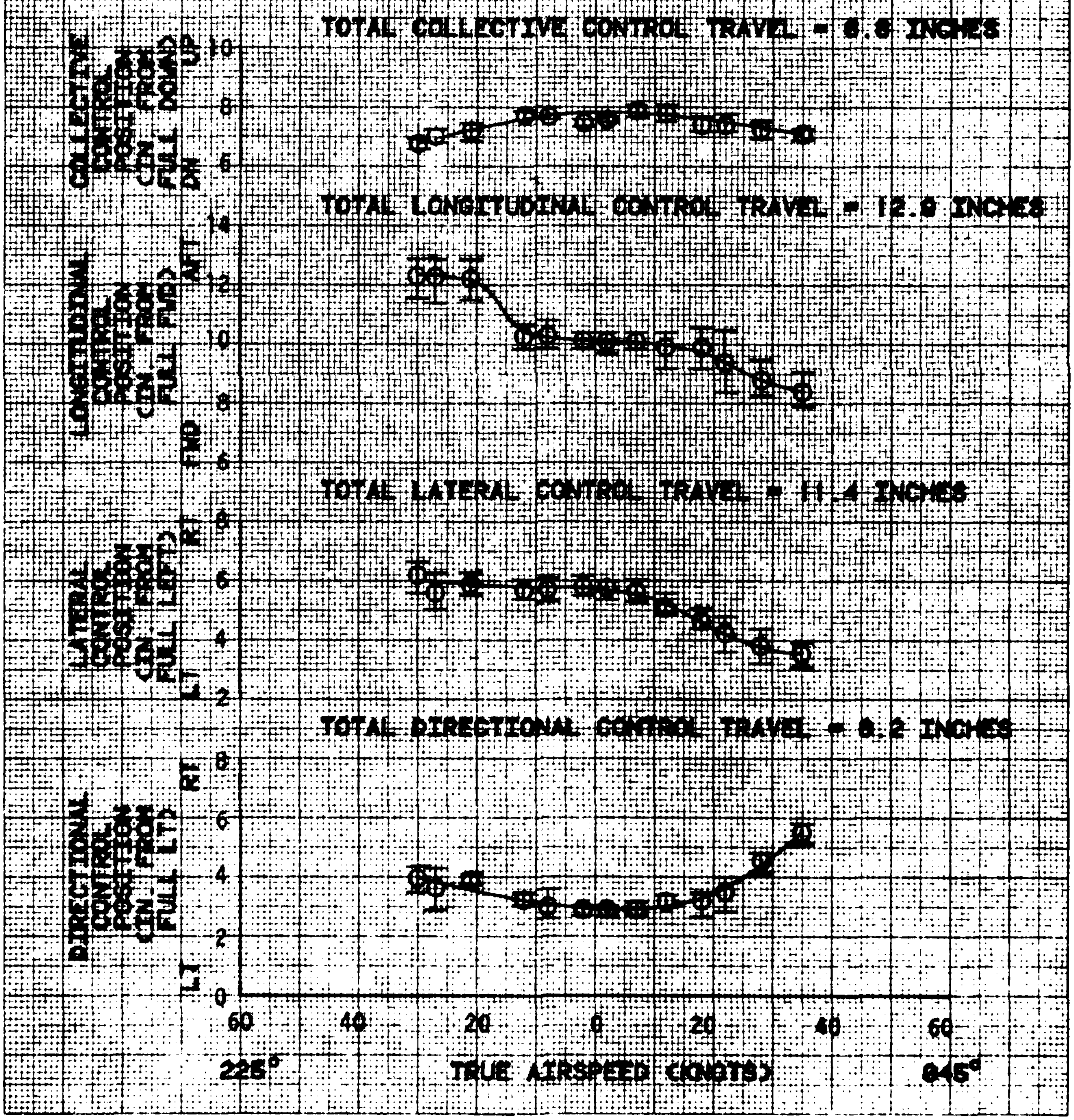


FIGURE 56
LOWSPEED FLIGHT
JOH-6A LOH (AH-6C) USA S/N 69-16064

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG SKID HEIGHT (FT)
2640	99.3(FWD)	0.5	6380	23.0	483	5

NOTES: 1. I DENOTES EXTREME TRAVEL FROM TRIM DURING ATTEMPTED STABILIZED POINT
2. WIND CONDITIONS LESS THAN 5 KNOTS
3. RELATIVE WIND AZIMUTH MEASURED CLOCKWISE FROM NOSE OF AIRCRAFT = 135/315 DEG

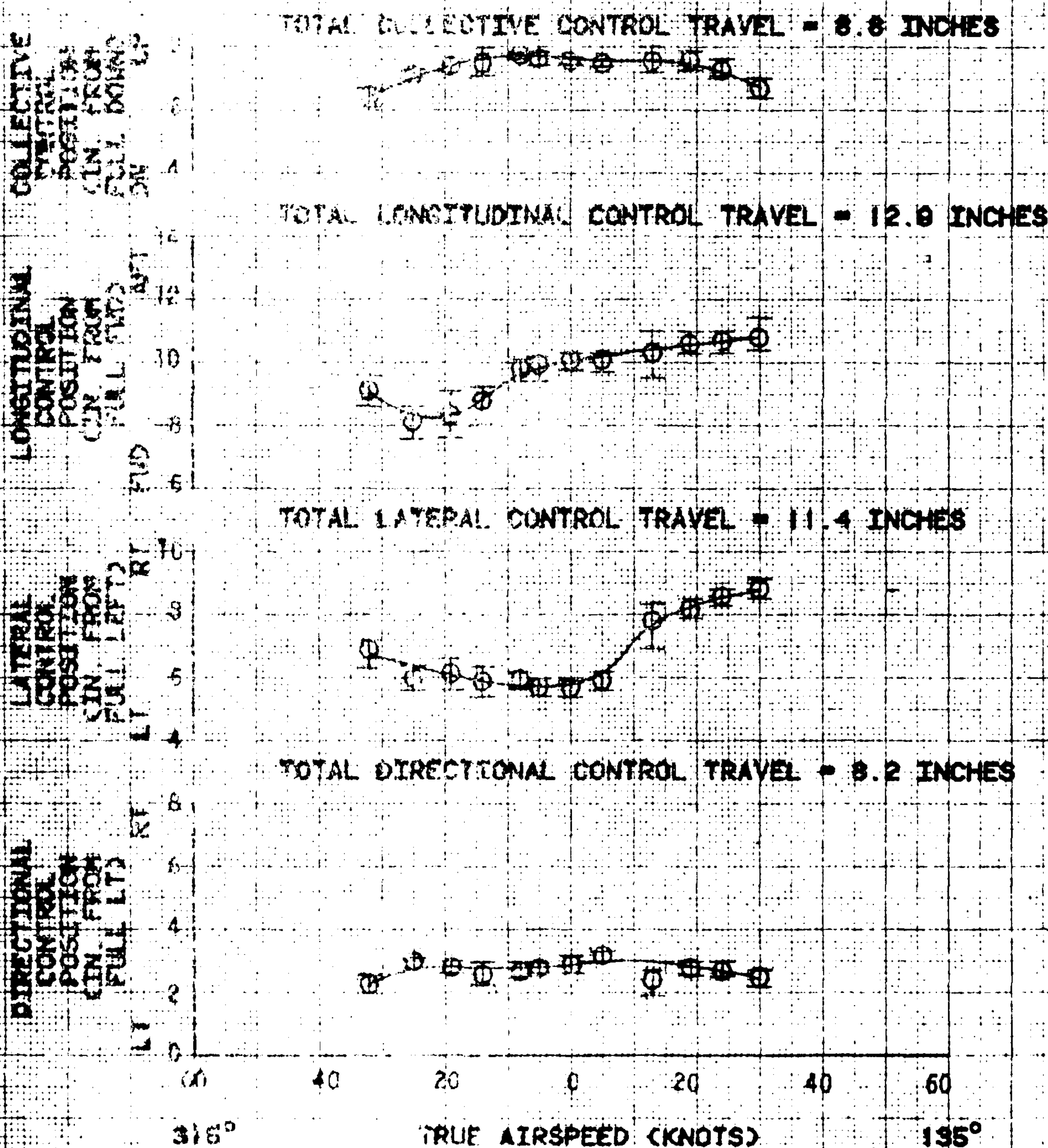


FIGURE 57
LOWSPEED FLIGHT
JOH-6A LCF (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG SKID HEIGHT (FT)
2640	99.2(FWD)	2.2(RT)	1800	25.0	483	5

NOTES: 1. I DENOTES EXTREME TRAVEL FROM TRIM DURING ATTEMPTED STABILIZED POINT
2. WIND CONDITIONS LESS THAN 5 KNOTS
3. RELATIVE WIND AZIMUTH MEASURED CLOCKWISE FROM NOSE OF AIRCRAFT = 045/225 DEG

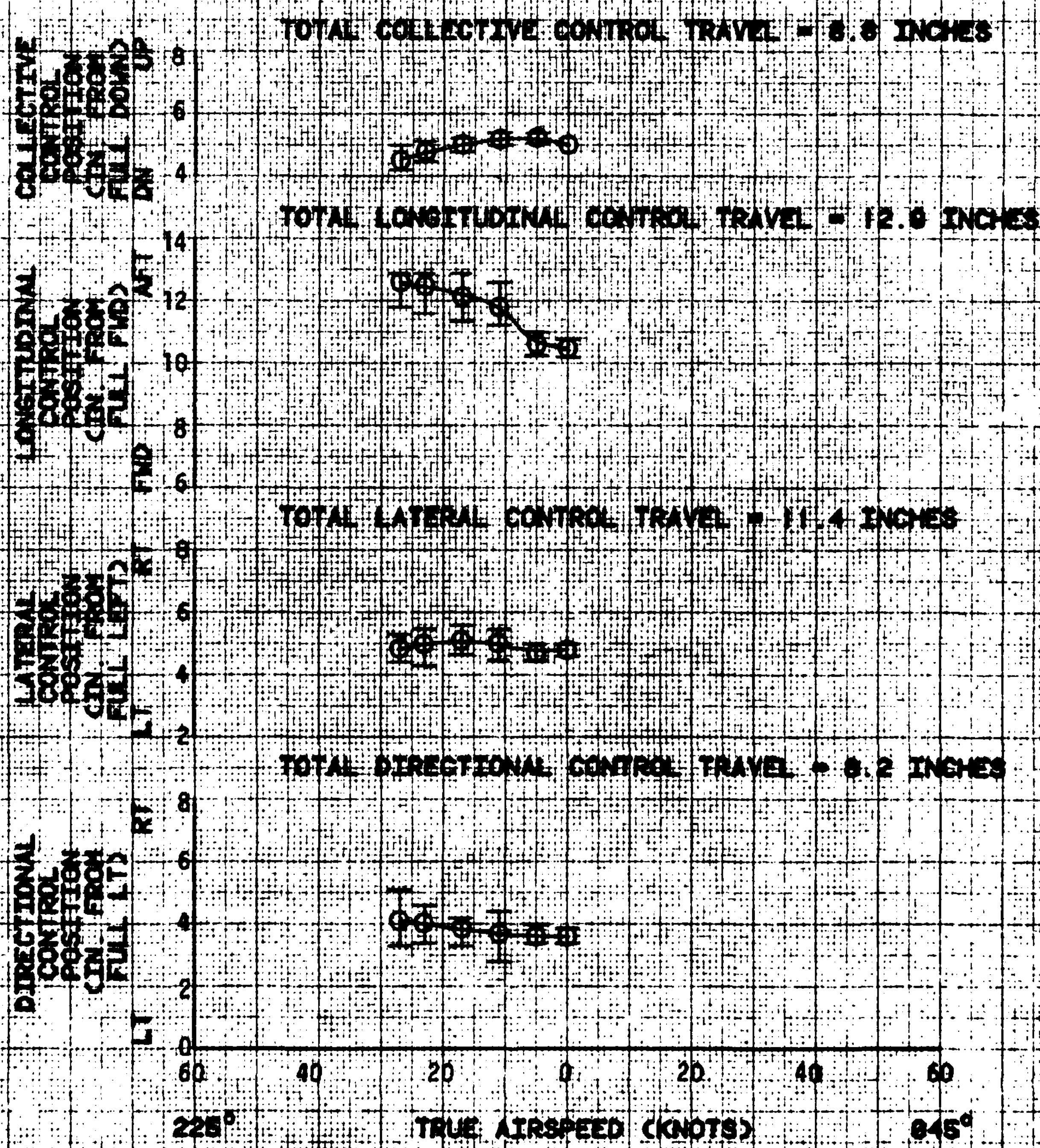


FIGURE 58
LOWSPEED FLIGHT
JOH-6A LCH (AH-6C) USA S/N 69-18054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	AVG SKID HEIGHT (FT)
2600	99.2(FWD)	2.2(RT)	5620	20.0	483	5

NOTES: 1. I DENOTES EXTREME TRAVEL FROM TRIM DURING ATTEMPTED STABILIZED POINT
2. WIND CONDITIONS LESS THAN 5 KNOTS
3. RELATIVE WIND AZIMUTH MEASURED CLOCKWISE FROM NOSE OF AIRCRAFT = 045/225 DEG

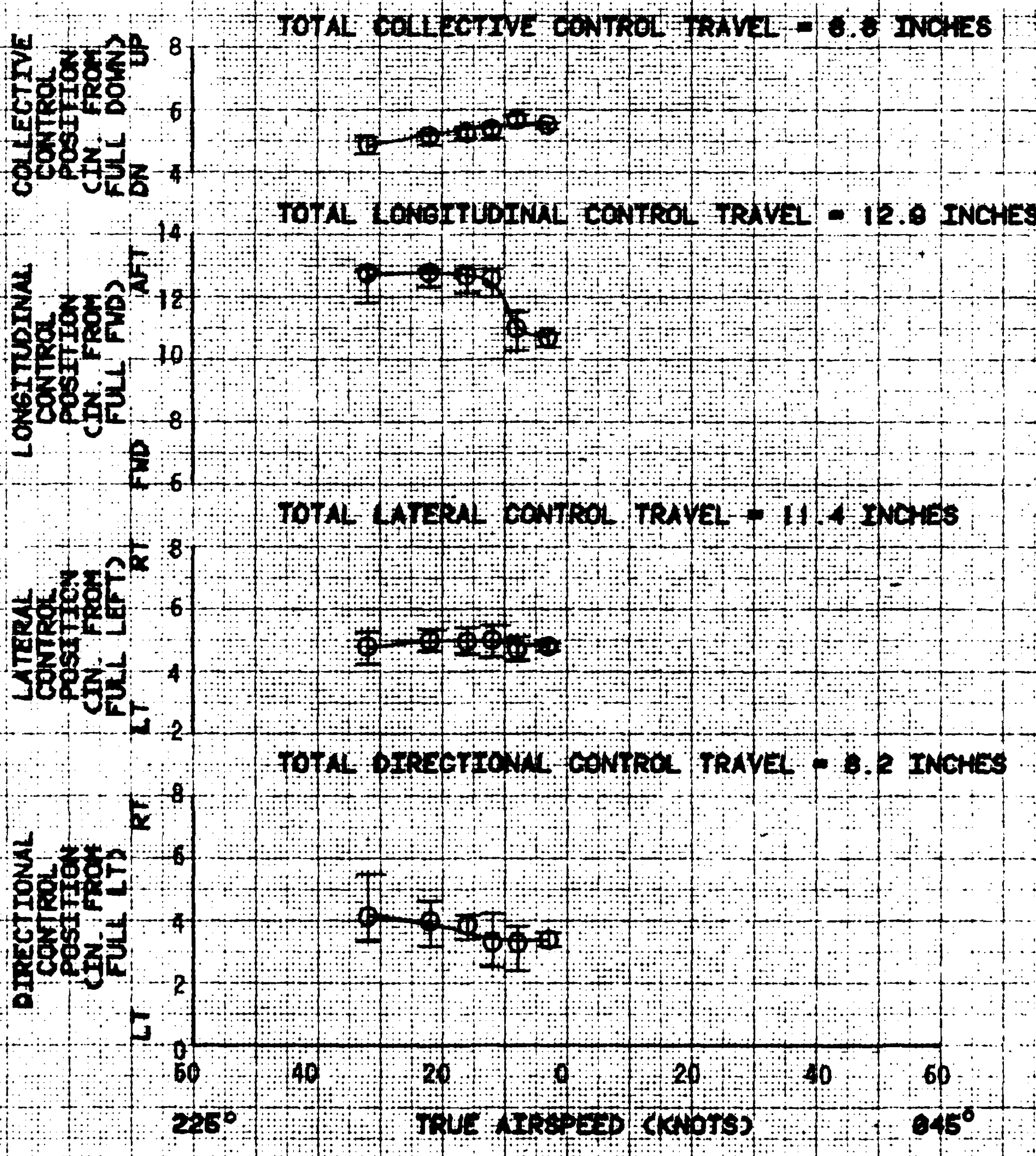


FIGURE 59

SIMULATED ENGINE FAILURE

JOH-6A LCH (AH-6C) USA S/N 69-16354

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	TRIM DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	TRIM ROTOR SPEED (RPM)	TRIM CALIBRATED AIRSPEED (KNOTS)	FLIGHT CONDITION
[illegible]	89.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

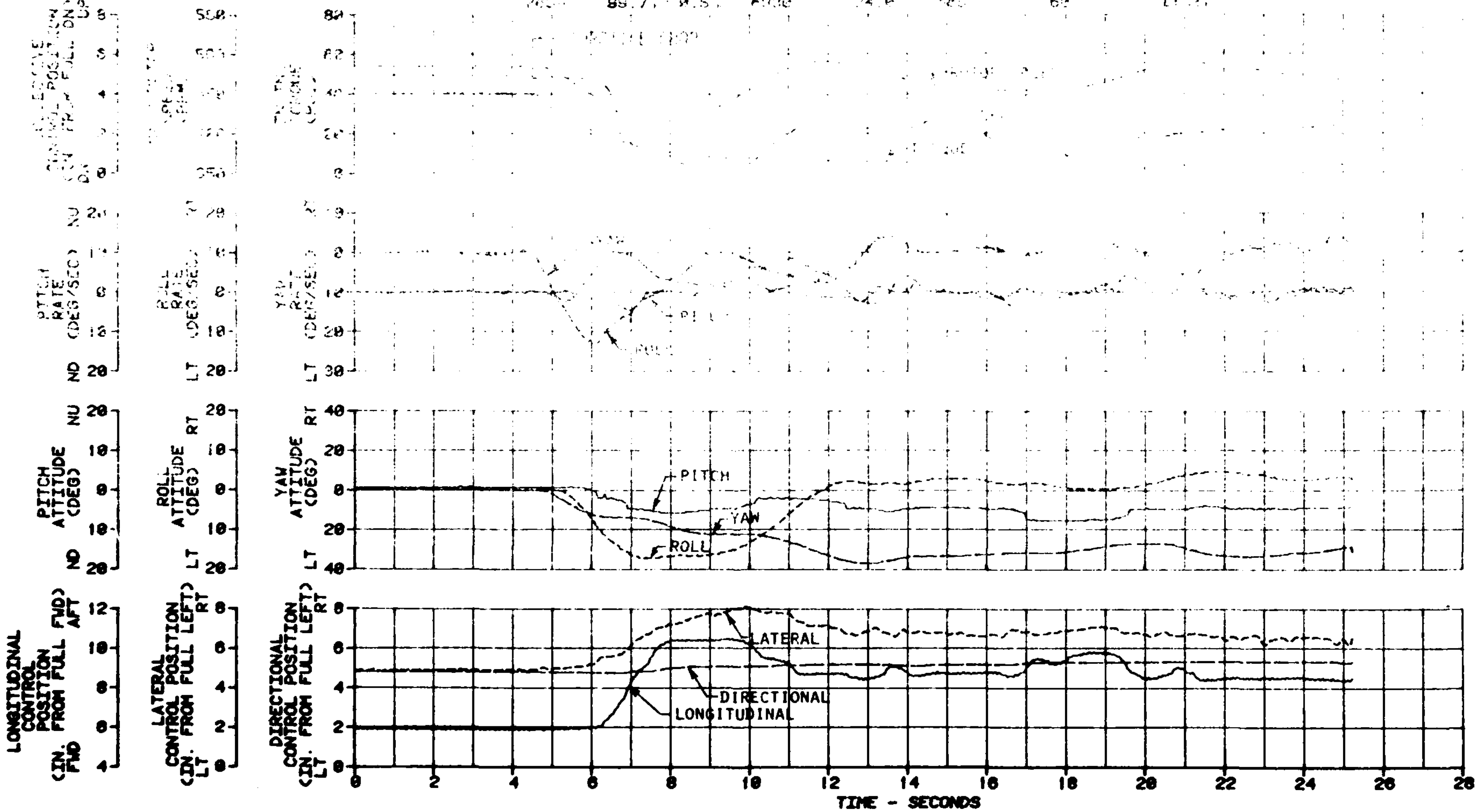


FIGURE 60
SIMULATED ENGINE FAILURE
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	TRIM DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	TRIM ROTOR SPEED (RPM)	TRIM CALIBRATED AIRSPEED (KNOTS)	FLIGHT CONDITION
2020	99.7(FWD)	0.5 RT	6020	24.0	466	76	LEVEL

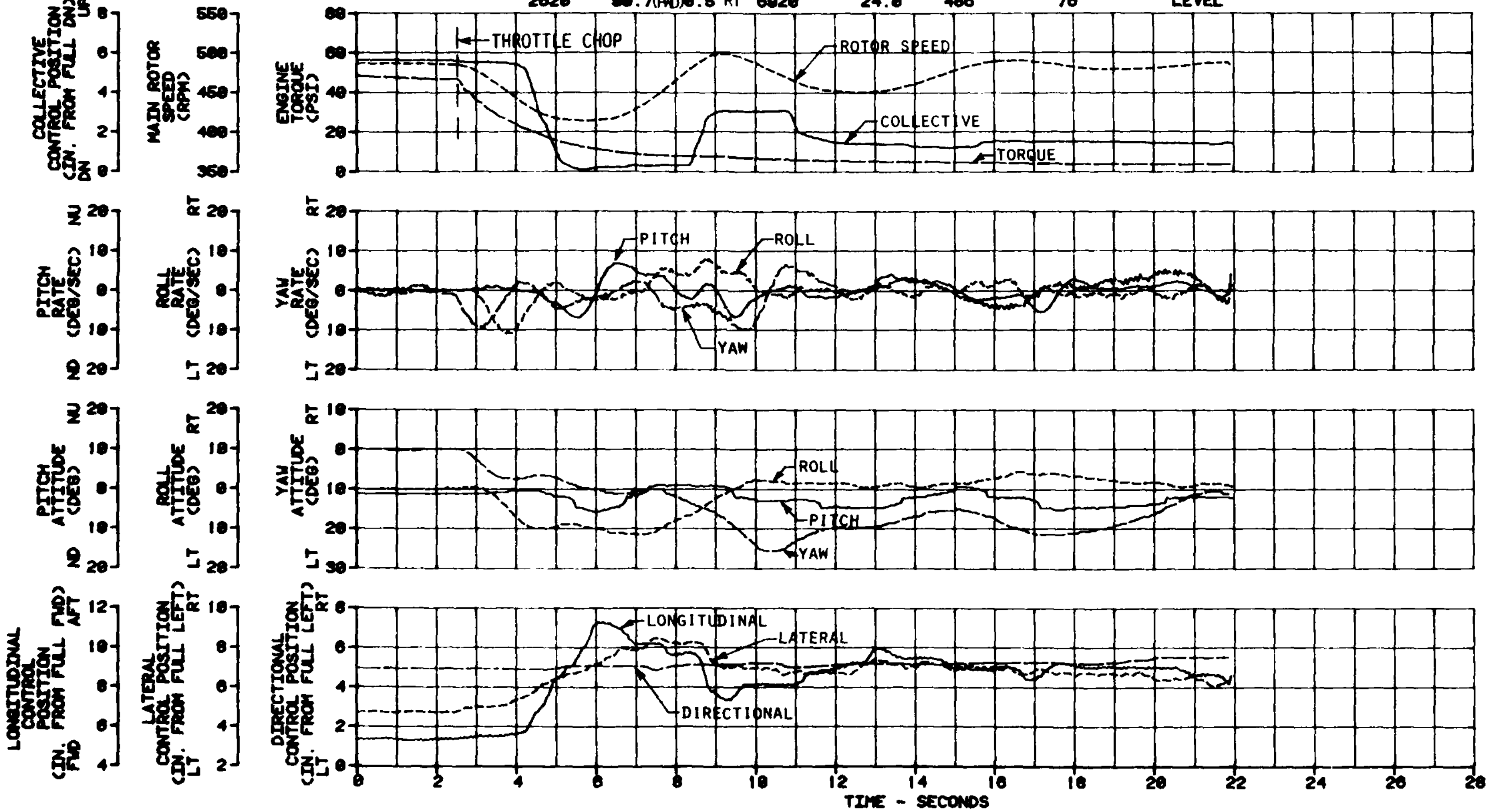


FIGURE 61

SIMULATED ENGINE FAILURE

JOH-6A LCH (AH-6C) USA S/N 69-16054

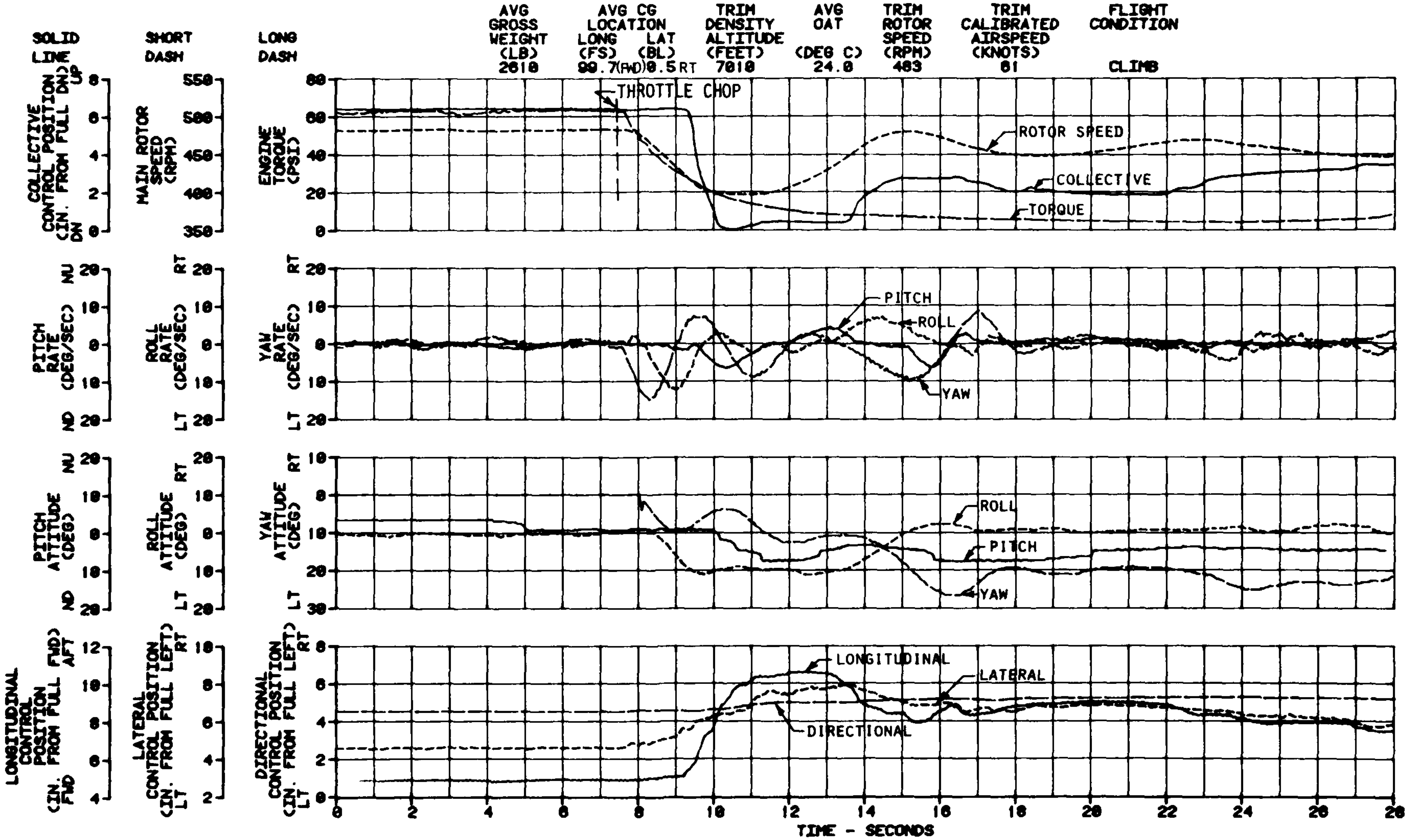


FIGURE 62

SIMULATED ENGINE FAILURE

JOH-6A LCH (AH-6C) USA S/N 69-16054

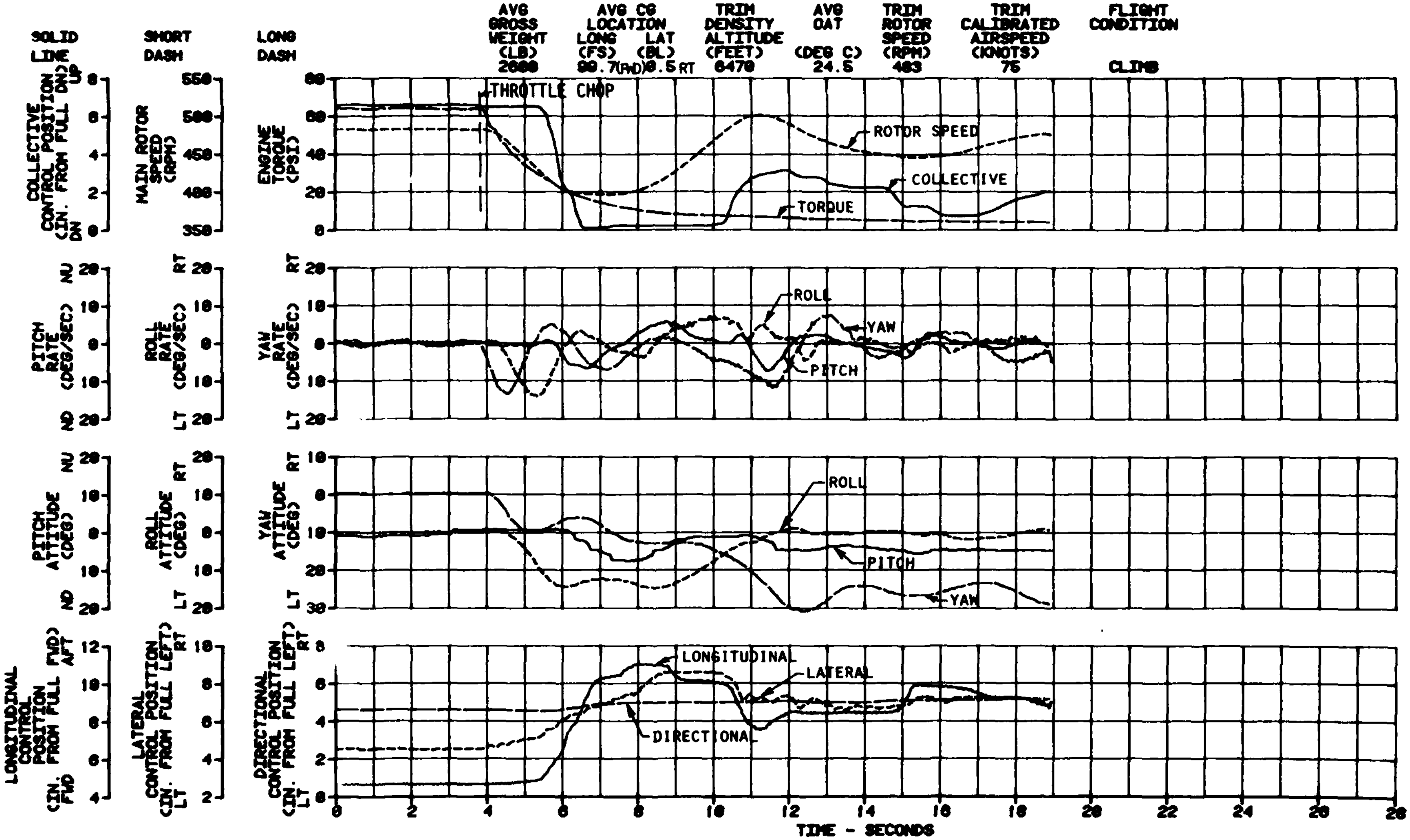


FIGURE 63

SHIP'S AIRSPEED CALIBRATION

JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
2020	99.1 (FWD)	0.5 RT	7200	27.0	484	LEVEL

NOTES: 1. TRAILING BOMB METHOD
2. STANDARD PITOT TUBE

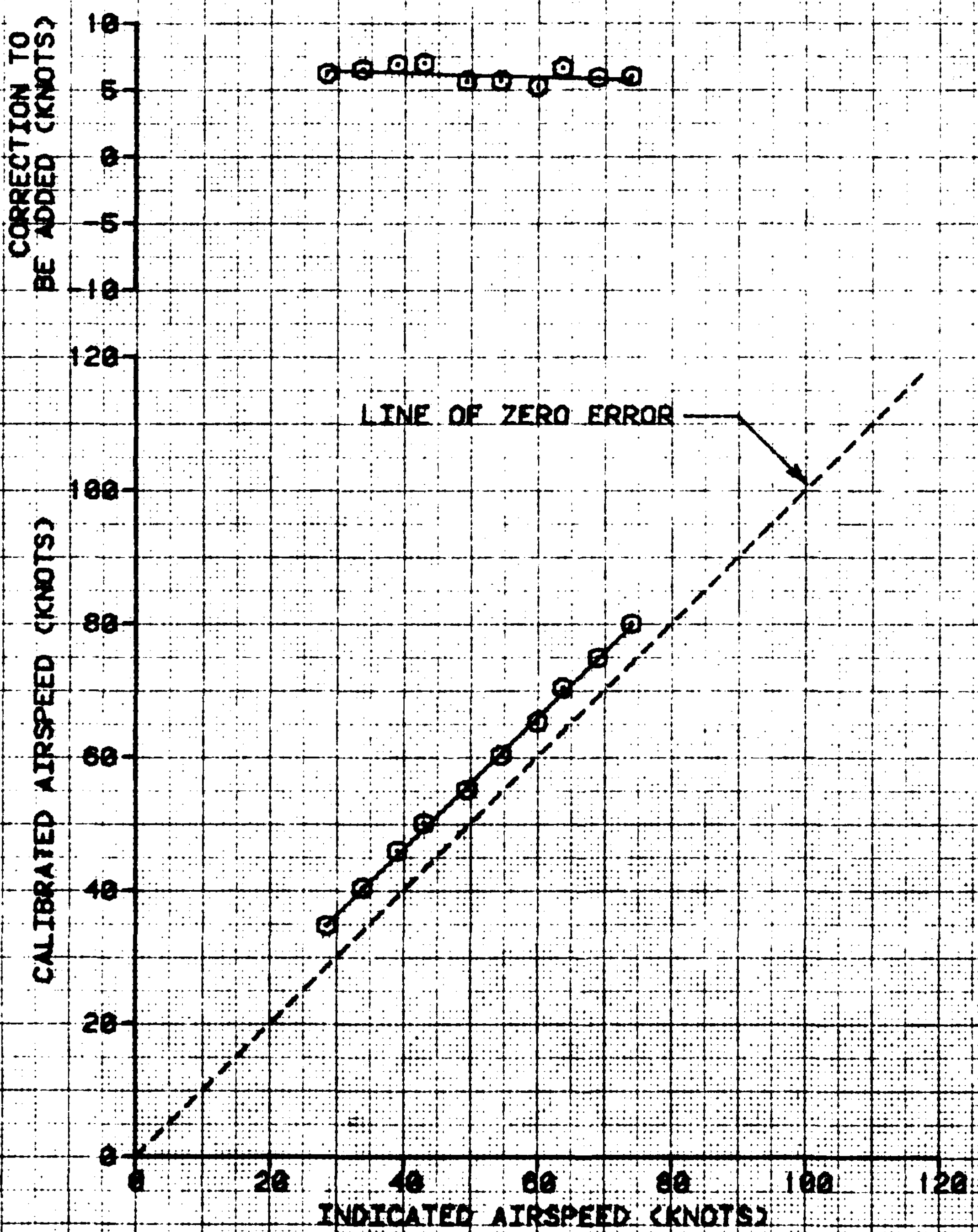


FIGURE 84

SHIP'S AIRSPEED CALIBRATION

JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
2580	99.1 (FWD)	0.5RT	7080	27.0	483	CLIMB

NOTES: 1. TRAILING BOMB METHOD
2. STANDARD PITOT TUBE

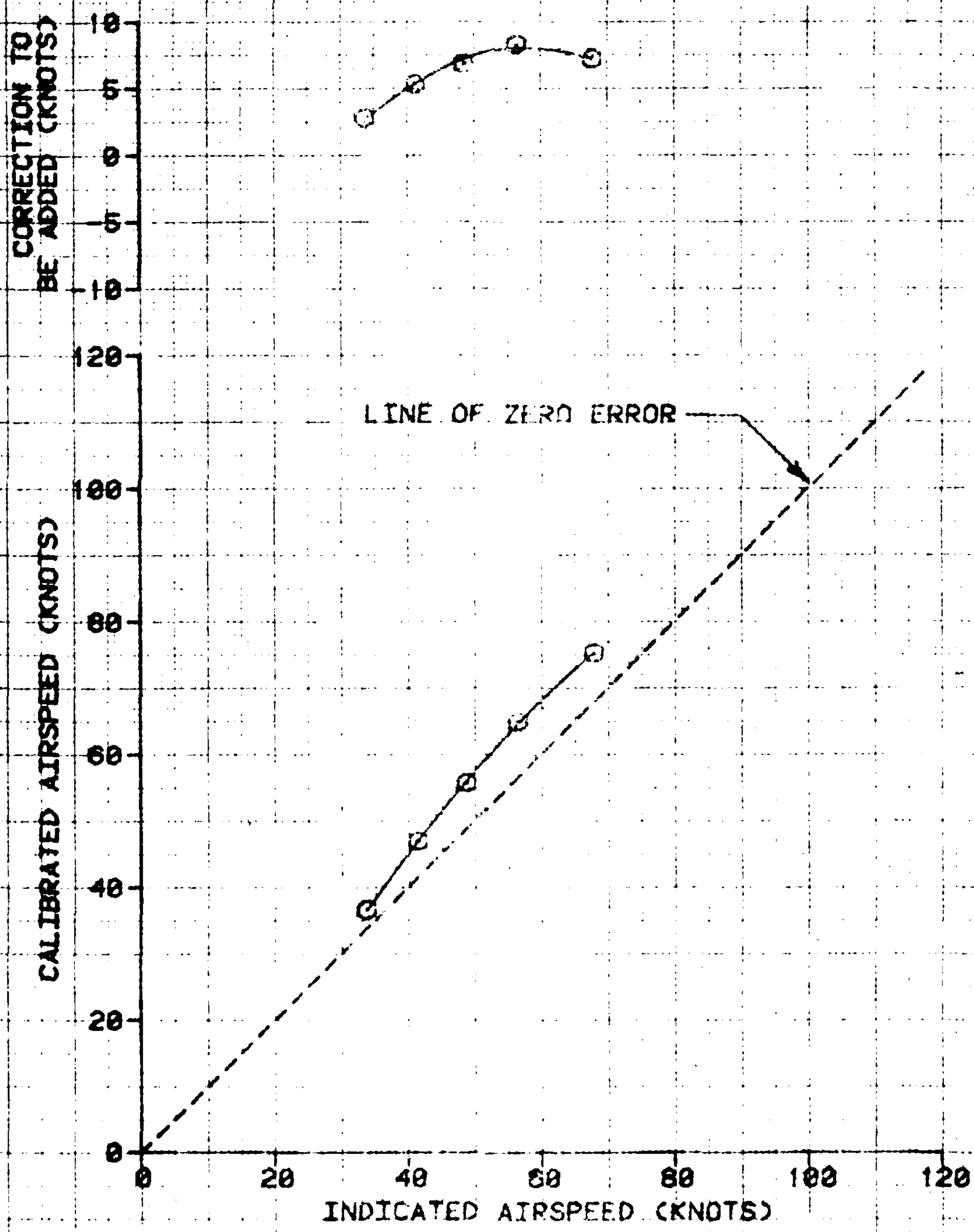


FIGURE 65

SHIP'S AIRSPEED CALIBRATION

JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
2580	99.1 (FWD)	0.5 RT	6960	26.5	480	AUTOROTATION

NOTES: 1. TRAILING BOMB METHOD
2. STANDARD PITOT TUBE

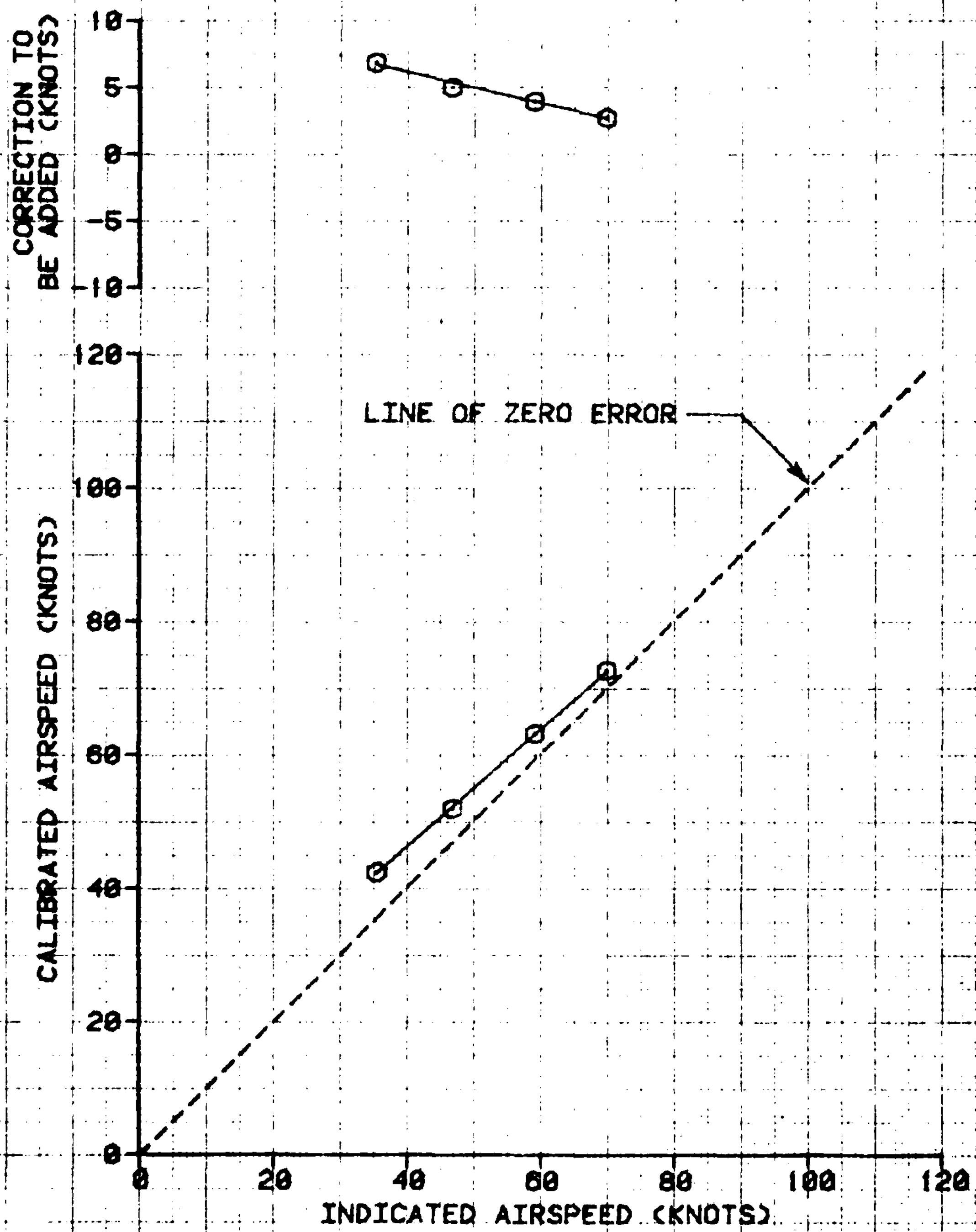


FIGURE 66
SHIP'S AIRSPEED CALIBRATION
JOH-6A LCH (AH-6C) USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
2620	98.9 (FWD)	0.5 RT	6600	19.0	482	LEVEL

NOTES: 1. TRAILING BOMB METHOD
2. EXTENDED PITOT TUBE

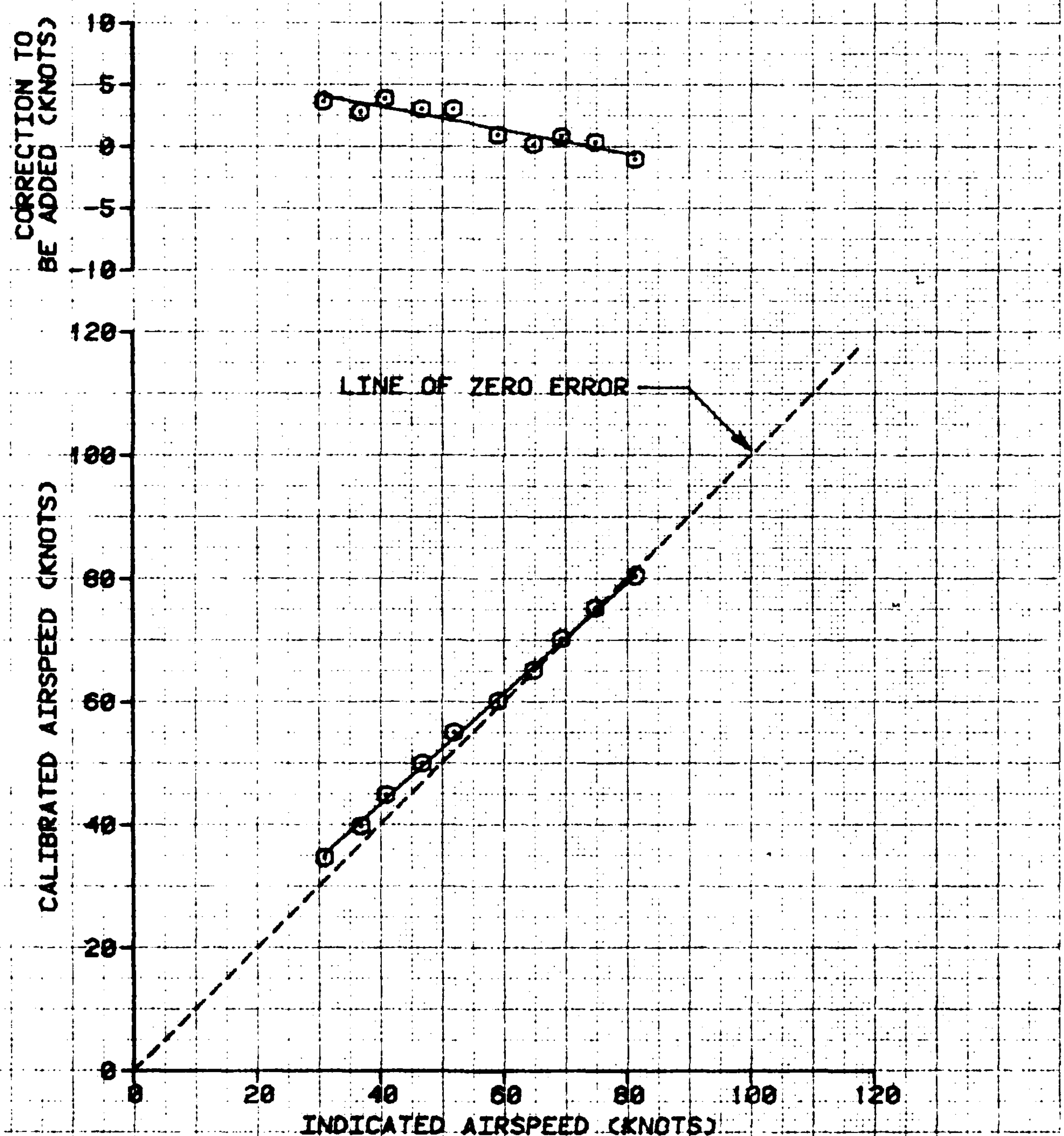


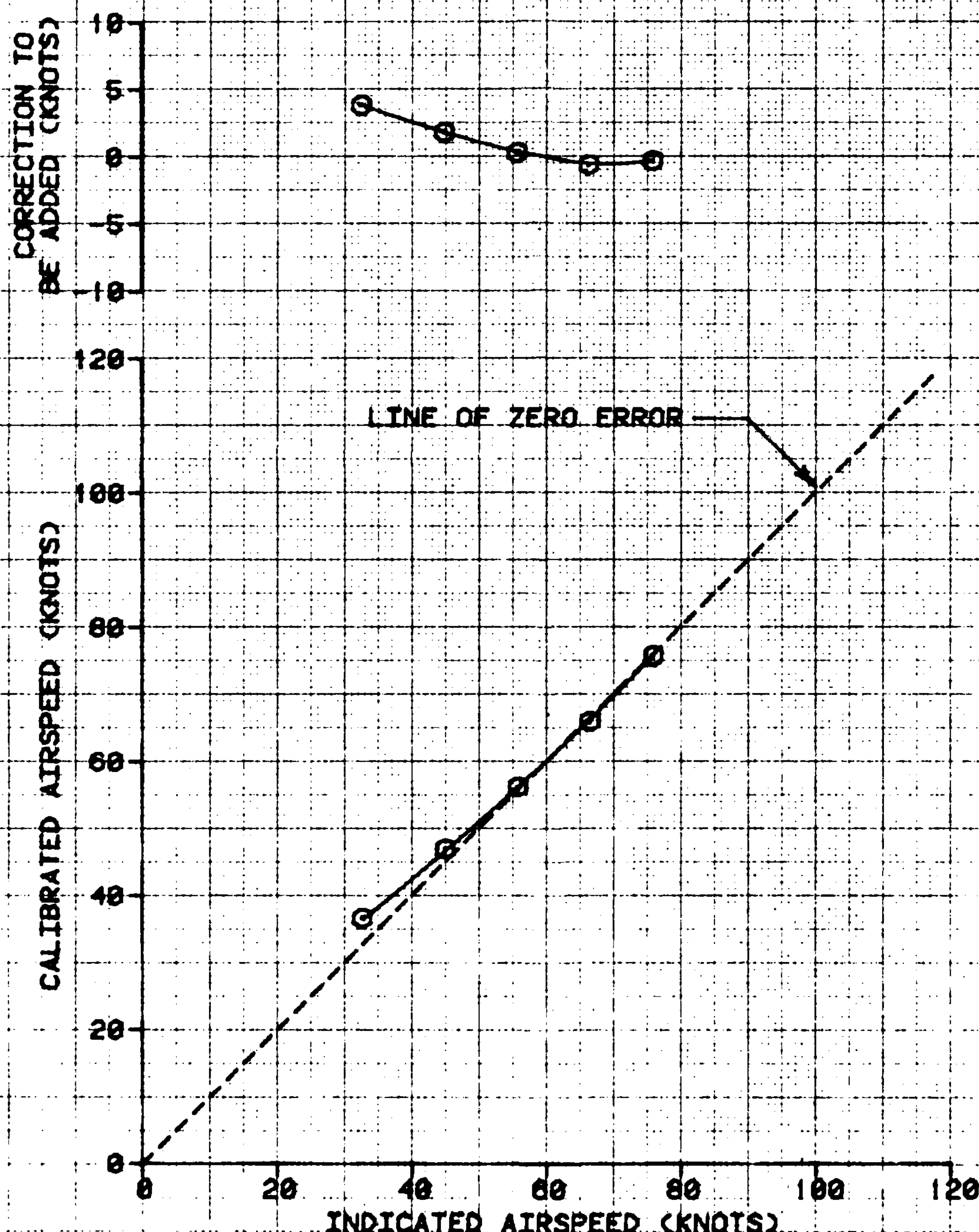
FIGURE 67

SHIP'S AIRSPEED CALIBRATION

JOH-6A LCH (AH-6C) USA S/N 69-16054

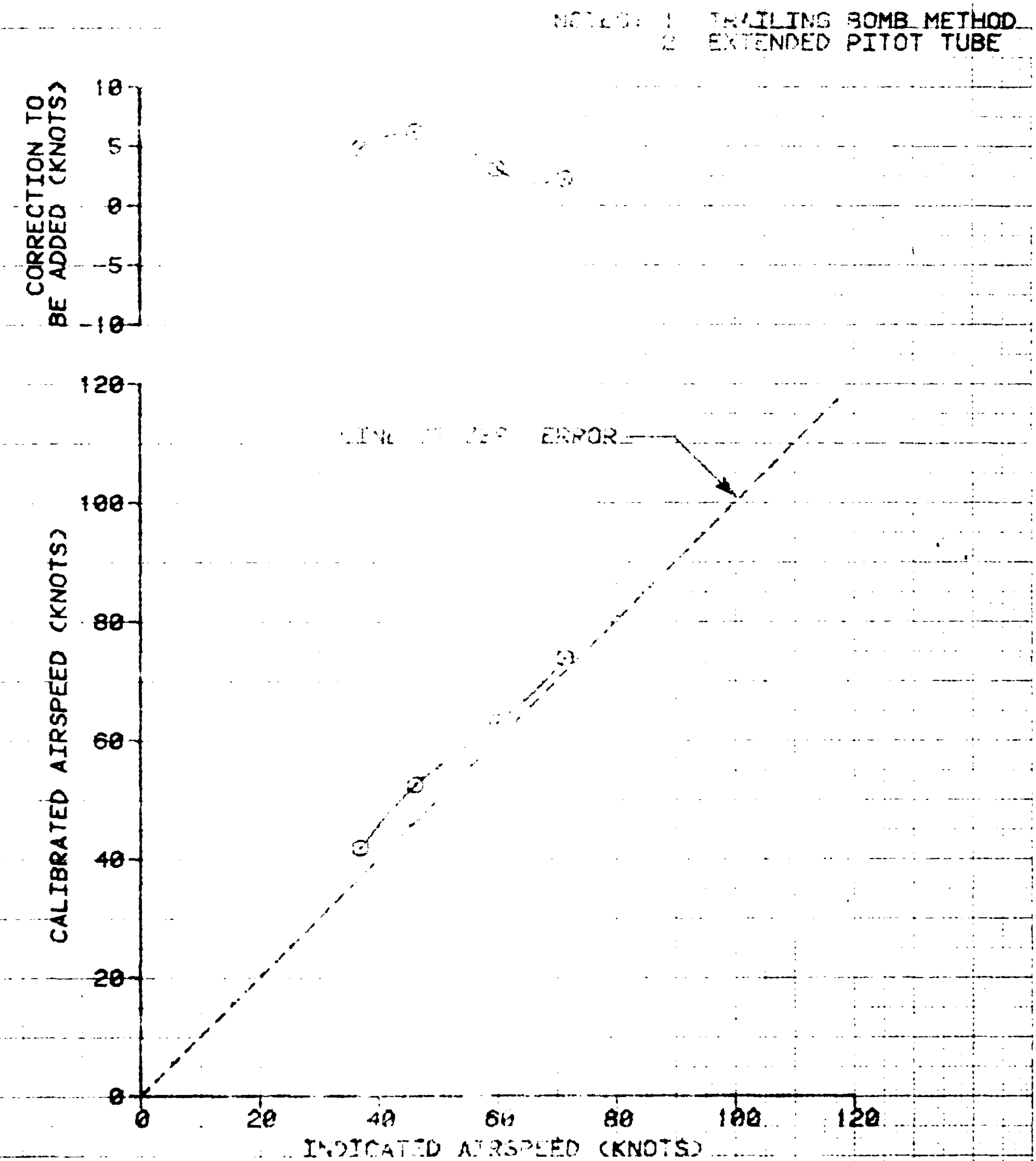
AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (DEG C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
2580	98.1 (FWD)	0.5 RT	6840	18.5	482	CLIMB

NOTES: 1. TRAILING BOMB METHOD
2. EXTENDED PITOT TUBE



SHIP'S [illegible] CALIBRATION
JOH-6A [illegible] USA S/N 69-16054

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	[illegible]	[illegible]	AVG [illegible] (DEG C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
2580	98.9 (FWD)	[illegible]	[illegible]	[illegible]	433	AUTOROTATION



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